Journal of the American Foundrymen's Association.

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PROCEEDINGS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION IN CONVENTION, MILWAUKEE, WIS., JUNE 9, 10 and 11, 1903.

TUESDAY, JUNE 9. Morning Session.

The President called the Convention to order at 10:30 a. m.

President Walker: It gives me pleasure to introduce Mr. W. J. Turner, Vice-president of the Milwaukee Foundrymen's Association.

ADDRESS OF MR. W. J. TURNER.

Ladies and Gentlemen and Members of the Association, it gives me great pleasure at this time to be able to address you in behalf of Mr. T. J. Neacy, the president of the Association. He requested me to extend to you the welcome of the foundrymen of Milwaukee to our city and to our association. Especially is it a pleasure to Milwaukee to have you here with us, for you are an association devoted to educational matters, and this is of particular interest to Milwaukee, for the interest that Milwaukee takes in all educational matters is well known. Milwaukee has progressed to a great extent in educational matters. It is perhaps in advance of many of the cities of the country, and I think almost of every city of its size, in this respect.

Milwaukee has at this time probably the best administrative system in its schools of any in the country and much of the success is due to the good faith and pride of its respected mayor in selecting the men to make our school board. The men who constitute the school board of the city are selected from the ablest men that we have, and they serve cheerfully. Many of them are members of our Association. One that I have in mind particularly has de-

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veloped in the public schools of the city of Milwaukee instruction in manual training to an extent that is equal to that of any city in the country. It is but a few years ago when as a member of our board of education the question of manual training came to the citizens of Milwaukee. That question came up in the shape of a proposition to establish a manual training department in one of our high schools. It started in a very limited way, but it increased rapidly and the system was extended. Instruction in cooking has also been established in the schools. The ladies of Milwaukee are progressing in their side of the training of the young. A number of the prominent ladies of Milwaukee got together and established a cooking school with money from their own pockets. It was a success from the start and has now been added to the regular school curriculum.

Now, Milwaukee has a large number of establishments manufacturing iron. It has perhaps, as you know, some 40 foundries. It has some of the largest machine works in the country. It has been given out that Milwaukee has specially promoted the industry of beer making. I will say this, though, gentlemen, for the beer, we will have it tomorrow night, and when we get through tomorrow night, I am going to ask you what you think of Milwaukee beer.

We have with us today the Mayor of the City of Milwaukee, and he is a gentleman of whom we are all justly proud. He is a man who has represented, and he does represent, all of the interests of the city of Milwaukee. He looks well after its public affairs, and he is a gentleman who has made more speeches, I suppose, at conventions than any other man in this country. We have had him for two terms and he is on his third. He has proved a splendid executive in looking after the interests of the city, and so good a man for addressing conventions, that, gentlemen. we will now leave the matter of the address of welcome to him and I will introduce to you the Honorable David S. Rose, Mayor of Milwaukee.

ADDRESS OF MAYOR ROSE, OF MILWAUKEE.

Mr. President and Ladies and Gentlemen of the Convention, I know of no citizen of Milwaukee who is better qualified to speak of the educational institutions of our city than the gentleman who has

just addressed you, because for many years he represented our city in an official way, and it is through his persistent effort, his enterprise, his progressiveness, perhaps as much as that of any other citizen of our city, that our educational institutions have attained to the excellent standard which they now occupy, and although he has been somewhat modest in expressing himself in respect to one of the great industries which we possess, I desire to give you the assurance that he is just as well qualified to speak of our beer industry and of beer as he is of our schools. (Laughter.)

It is certainly a pleasure to meet this representative gathering of business men here upon this delightful morning of June in this most delightful of all the cities of the nation, and when I make this statement I am not oblivious to the fact that the President of your Association comes from the city of Boston. We have had some peculiar experiences with the people of New England. As a matter of fact, it was the New England people who founded this city. They were pioneers; they were our fathers. They were succeeded by the Germans, and it is that character which predominate in our great cosmopolitan population. The sturdy, thrifty, progressive, cautious, honest German character that succeeded those who builded perhaps better than they knew. To my mind it is proper that those of you who are engaged in this industry should make Milwaukee the selection for an annual assemblage, for in truth Milwaukee has come to be regarded, and justly too, as one of the great manufacturing cities of this nation. Our manufactured product last year amounted to upwards of 230 millions of dollars, and in our manufacturing institutions we give employment to about eighty thousand operatives. It is true, as Mr. Turner has said, that Milwaukee has acquired a peculiar reputation, perhaps because of her great brewing industry; but when we speak of the brewing industry in comparison to the other great industries that we have, it sinks almost into insignificance. The total amount of our beer product is about 20 millions of dollars, while the value of our manufactured iron products exceeds eighty millions of dollars.

We not only have the greatest breweries in the United States, but we have the greatest iron working industries of their kind in the whole world—the manufacture of stationary engines, mining and milling machinery. We have the largest tanneries in the world. We have the largest trunk factories in the world. But it is through

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the great advertising that has been done by our breweries that beer has become known as the principal product. It is our desire to dispel this delusion, and to lead the public mind into the proper channels, because, while we are not ashamed of this great industry, that has done so much for our city, we feel that justice should be given where justice is due, and when that is done Milwaukee should be celebrated as one of the great iron manufacturing cities of the world. We undertake to keep pace with our sister cities in the range of progress. In individual effort, it is the friction of competition that brightens, and in cities of our class we have learned it to be a fact that it is the same spirit of competition that broadens and developes the perfect city.

Our educational institutions compare favorably with those of any other large city in this nation. Our common school system is a part of the common school system of the old Badger State that has in its excellency placed her in the foremost rank as an educational State.

We point with pride to our public institutions; to our splendid city hall, erected at an expense of a million and a half dollars; to our library-museum building, which stands as a monument to the enterprise and patriotism of our people, because it has cost upwards of three-quarters of a million dollars. In the Public Museum we have the fourth largest collection in the United States, and about 220,000 volumes in our Public Library, and you can go every afternoon or evening and there you will find the youth of our city diligently prosecuting their studies in that great educational institution, preparing themselves to enter upon that splendid citizenship of which we feel we are justly proud.

You come at one of the most propitious seasons of the year. You come in this month of June when nature is clothed in her loveliest garb, and I trust that you who are strangers here will find the opportunity to visit the resident districts of our city; to visit our parks and pleasure resorts. Milwaukee was confronted in respect to the organization of her park system by the same problem that has been presented to those who are clothed with responsibilities of office in all of the large cities of our nation. The question as to whether it would be better to have one or perhaps two large parks or a large number of small parks came up, and those who were clothed with responsibility and with the authority, in the exercise of

what I esteem it to be most excellent judgment, decided upon the latter plan. As a result we have a large number of small parks equitably distributed throughout our territory lying at the threshold of the homes of our laboring population as well as nigh to the palaces of the rich, and thus affording to the poorer classes those luxuries which only the rich enjoy in too many of our large cities. Our labor is of the best. Our laboring men own their own homes. This insures conservatism.

At times we have been afflicted as other cities have been by strikes, in fact, we have now a strike upon our hands involving about three thousand men; but in every strike that we have had under the five years of my administration—and of that time I am speaking advisedly—perfect order has prevailed.

We have no tenement house districts. On the contrary, as I have stated, our people own their own homes, and if you will go into the outskirts you will find there their cottages surrounded by healthful environments and by verdure, foliage and flowers.

I believe I am safe in saying that our city today offers more and better inducements to the investors seeking a location than any other city of this nation. We lie here at the very basis of the supply of raw materials. We have here the lake to bring us the iron direct from the iron mine; to bring us the lumber directly from the saw mill. We have here every facility that is required by the manufacturer, especially every convenience that he desires for the purpose of profitably conducting his business.

We can give you absolute assurance of the very best fire protection and the very best police protection. We can give you the assurance that here you will find conservative skilled labor. We can give you the assurance that here you will find the lowest city tax rate of any large city in this nation. We can give you the assurance in transportation rates for the products you may ship as satisfactory as can be furnished by any other city in this nation.

Our splendid harbor is the very best on the great chain of lakes. We have upwards of 40 miles of excellent dockage. We can accommodate the largest craft that floats and we have an abunance of room to spare.

In the administration of our government we are controlled by the old fundamental democratic principle that that government is

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best that governs least. The easterner would characterize it as of the western policy. We have upwards of 1750 saloons, a matter that may be of no interest to you gentlemen. I only speak of it as an incident and they are never required to close their doors from the beginning of the year until the closing of the year, and yet you will see fewer intoxicated people upon our streets than any other city in our broad land. Property and life are absolutely secure, and you may go in any section of our city at noonday or midnight with a sense of obsolute and perfect security.

I tell you that we have the best police department in this nation. Perhaps you will be interested in that, but I wish to give you the assurance that upon occasions of this kind our police recognize every man who wears a badge as a guest of honor in our city. They have instructions to barricade the doors of our police stations to keep our visitors from breaking in. (Laughter)

Gentlemen of the Convention, I trust that your deliberations will be profitable to yourselves and between your sessions you will find opportunity to visit the many points of interest which our city can present; and let me make this further suggestion that if you can take time to make this visit the beginning of your annual vacation, I will say that you have come to the most delightful resort on the face of this broad earth. This is a sample of our summer weather. You can expect this every day in the week and you will not be disappointed very often.

Lying near to us are innumerable beautiful summer resorts that can be reached by the electric cars or by direct connection by steam cars. We have in Wisconsin 1242 inland lakes, most of them well stocked with fish, and you can make Milwaukee the basis of your operations and spend a most delightful month in Wisconsin. Of course, Milwaukee wants to get all out of you that it is possible to get from you.

In behalf of our people I extend to you a most hearty and cordial greeting and I trust that when your labors here are closed and you return to your respective homes that you will carry with you only pleasant memories of your visit to the Cream City of the Lake.

President Walker : I will ask Mr. Willis Brown, of Erie, to respond to this address.

ADDRESS OF MR. WILLIS BROWN.

Ladies and Gentlemen, and especially his Honor the Mayor, and the representative of the Milwaukee Foundrymen, my pleasure in undertaking this task is only exceeded by my embarrassment in finding out that I am to follow in the footsteps of the eloquent men I have listened to. It will be difficult to say anythiny along those lines.

I can say, however, on behalf of the American Foundrymen's Association that we accept your cordial and hospitable welcome in the spirit in which it is extended.

We have been desirous of coming to Milwaukee for two or three years. We have been told during that time that Milwaukee was a bright spot. Of course we all believe and will continue to believe everything about Milwaukee that we are told by a Milwaukee man; seeing is believing, and we are finally here for the purpose of investigating the bright spot.

There is only one discouraging feature that I noticed in the Mayor's addrcss, and that is the amount of beer is not as large as I supposed it was, but I really hope there will be enough to go around. He has exaggerated the quantity of iron. Now, he will discover before the A. F. A. gets away that it is a great deal easier for men to take beer than it is iron.

Last year our Association met in Boston, and now in Milwaukee. In other words it is from beans to beer. We can make the comparison a little later.

I had a friend once who came to Milwaukee to attend a convention and when he got back I asked him what he thought of the quality of beer at Milwaukee. He said, " well, it was in August when we went there, when I got there I was so thirsty that I did not stop to consider the quality, and after the first few glasses I really didn't think any more." At all events I trust that the hopes of the Association will be realized, and when we take our departure we will realize that we have made friends in Milwaukee who will be friends of a life time, and I trust that the feeling on the part of the Milwaukee Foundrymen will be that they will be glad to have the A. F. A. come back again at some other time. I think that you will discover that generally speaking the A. F. A will be found to be one of the most taking of all Associations, and when

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they have taken of everything else, and partaken, and finally taken their departure, anything that they leave here in Milwaukee you are entirely welcome to.

President Walker: I can say for the visiting fraternity that they are very much pleased at their reception and for the very complete arrangements that appear to have been made for our meetings; that the weather has been arranged for us, and those who have read the morning paper will find that they have even undertaken to tell what we do evenings.

Milwaukee is indeed entitled to much credit. It was near here that our Secetary was born, and doubtless that will account for his love of attention to detail and for his great interest in matters concerning the Iron Industry.

In this very complete programme which has been given us, we are told many interesting things about Milwaukee. I find in this Encyclopedia that while they indeed have established school, they established the tavern first and the schools came afterwards. I also notice, though I may read incorrectly, that some 60 per cent of all the people have been arrested. Now, I hope that the visiting brethern will use due care not to increase this percentage, which already seems unusually large. I hope the intelligent brethern will also remember that this book says that navigation never closes in Milwaukee, and it also says precipitation is well distributed throughout the year, being heaviest in mid summer. The Secretary has a telegram he will read.

Secretary Moldenke: We have a telegram from Hoosick Falls, N. Y. from our Vice President Mr. James A. Beckett expressing his regret at being unable to attend and sending his best wishes for the success of the meeting.

President Walker then read his annual address as follows:

ADDRESS OF THE PRESIDENT MR. ARTHUR W. WALKER.

The close of another year brings us again to a statement of the conditions and affairs of our Association, and the general conditions and outlook of the trade.

The most important change within the Association during the year is the establishment of a section for foundry foremen, and also

a section for foundry metallurgists. The former was created in response to a request from the association of foundry foremen now existing, who desired to affiliate with us, from an educational standpoint, which is theirs also. The negotiations which were authorized at the convention in Boston, were afterwards concluded, and were quite simple in character. It was shown by the constitution of the Foremen's Association that their object was purely one of mutual benefit through educational method. Your Executive Board therefore placed them upon the same basis as the local foundrymen's asssociations now affiliated with us, as to annual dues. It was further agreed that inasmuch as the volume of the convention busidess warranted its subdivision into sections, that questions and papers relating to the practical operation of the foundry be delegated to the foremen's section, they having charge of one session of the convention, for this purpose. A chairman and secretary were appointed to carry this out efficiently. Similar action was taken with respect to the metallurgical questions now so frequently arising. A section for Foundry Metallurgists, authorized by the Association at its last convention, has been duly established, and a chairman and secretary appointed.

By subdivision of the work in this manner, and the appointment of officers for the sections, it is intended to enlarge the usefulness of the Association, as well as give members attending the convention an opportunity to select those subjects most interesting to them.

It was agreed that all matters coming up at the sections, as well as in the associations affiliated with us, would be published in our Journal, if of interest to the Association at large.

It is further agreed, in view of the demand generally expressed, that steps be taken to organize sections for pattern foremen, and for foundry accountants, both of these branches of office and work management offering lines of standardization which would be of marked value to the industry in effecting economies.

Something might be done for our apprentices in the way of education in their trade, when they cannot avail themselves of schools or correspondence schools. If it were possible for foundrymen to obtain short instruction papers from our Association on subjects related to their work, for distribution among apprentices and men, it is probable that interest would be created; and many of the

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younger men could enter the present correspondence schools, or the hoped-for trade school for molders. The members of the Association might receive great benefit from such a course.

Regarding the condition of the trade from a business point of view, we have passed through a year of extremely high values. No one can be sure whether this period will long continue. Prices for coke appear to have receded permanently, and values of pig iron are somewhat lower, with a tendency slightly downward.

We have passed through the difficulties of a rapidly rising market. I hope we shall not experience the trials of a rapidly falling market, which is, in my belief, even more difficult for the manufacturer. It requires high ability to manage a business with satisfactory profit while prices are falling. I suppose we would all prefer that, a high level as to costs having been reached, present conditions might continue indefinitely. Let us then hope that such may be the case, but it does not seem possible that such hopes will be realized. Perhaps the best we can expect is that the fall in values may be uniformly distributed over a long period.

I believe it appropriate also to refer to our relations to those employed by us, commonly known as the "labor problem." This subject is prominent in many foundries, and will require our best thought and judgment for some time to come. I will speak briefly of the lines which have been thus far followed in its development.

Since the close of the Civil War, the wonderful growth of manufacturing industries has brought into prominence the various labor unions. They have been the natural result of existing conditions. Inexperienced and crude in organization and method, the unions at first made demands which could not be granted without a struggle. Strikes were therefore frequent, some of them serious, many of them unjustifiable, and for a number of them the blame might be placed upon the employers.

From these earlier methods of dealing with labor. we have developed the condition of the present, which may be described as one of better organization on both sides. Some of the unions have become national in extent. Many employers are also affiiliated, in associations for united action and defence. Each side has a large fund to give support to any course it may determine upon. Such reserve power tends to make both sides reasonable. We have gained in experience, and better understand the fair and equitable

settlement of business problems by the application of common sense. In our industry this is the state of things today. Many prominent employers believe we have attained the ideal relation between capital and labor. We have certainly improved upon earlier conditions and yet from a certain point of view these present methods are but a step forward, and do not reach the final ideal. We may therefore expect to modify or abandon them later.

The present situation in our trade—a powerful labor organization on one side, and no less powerful associations for defence on the other— is similar to that of the nations of the world, with respect to their naval armament. As strong navies are a guarantee to continued peace, so large and constantly increasing funds available for instant use by these strong organizations may insure industrial quiet. But great military and naval strength, while doubtless the most practicable peace-maker now, will in some period be obsolete for that purpose. As the increasing effectiveness of modern weapons makes war absurd, unreasonable, and finally impossible, so large reserve funds may in time cease to be the chief reliance in dealing with labor.

If then, our present ways of dealing with this subject seem to fall short of the ideal, what methods will in time replace them? We cannot expect past or present notions to suit the new and ever-broadening future, in this or in any other department of our business.

I do not assume to have the gift of prophecy, nor to be more enlightened than other men, but I beg to offer a few suggestions which may indicate the probable future trend of thought and action in dealing with the labor problem.

In the first place, then, we must have the same common sense and progressive spirit in handling labor as in the development of new processes. We cannot expect present methods of manufacture to long continue, neither can we hope that the present manner of dealing with labor will remain satisfactory during the next ten or twenty years.

Neither can we expect in this country to permanently withhold from our workmen a fair proportion of income from manufacturing enterprises, Nor can we hope to crush labor unions, or by large defence funds to settle finally the economic questions involved. The manufacturer who is wisely building for the future will study to

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work with his employees rather than against them, to please them; to unite his managing ability with their muscle and skill. If new methods of dealing with labor problems are to be in this direction, it may require a change of heart on the part of many.

The health and comfort of workmen in the shop is a matter so old it is hardly necessary to refer to it. We cannot expect a workman who is uncomfortable, and trying to perform a difficult operation without sufficient light, or air, or adequate appliances, to be in a frame of mind suitable for working wholly in his employer's interest. For some, therefore, a first step in the establishment of cordial relations between employer and workmen may be to study the comfort and convenience of employees. This is, however, only the first step; others will be clear to any employer who approaches the subject with an honest desire to do what he can.

We shall come to understand in the future that a manufacturer should be willing to pay the highest wages that the state of his industry will permit; his workmen are his partners; why should their welfare not concern him even more than that of his customers?

It may be well to inform employees relative to the business details of any enterprise When a factory is busy, they suspect enormous profits. They do not understand, nor consider the relation of cost to selling prices. They cannot know whether orders are filled at a loss, were various expenses considered. If such information could be given it would make men more reasonable in their requests. An easily-raised objection is the tendency of such a course to advance wages in prosperous times; but the liberal minded manufacturer will not object to this. When dull times return, the men must expect the inevitable reduction of wages; if they are entirely satisfied that they are based upon the true state of the business, they will accept such reductions with content. The manufacturer must be honest with his men, and his men will be honest and fair with him. The American mechanic wants to be treated squarely. If he is sure of this, he is willing to share with his employer the burden of dull times.

I am not saying that the earnings of the men should be in direct proportion to the profits of the employer; but earnings do and should bear some relation to profits. Many contests have arisen over this matter, some due to insufficient information, or an unreasonable concealment of real conditions by the employer.

I believe in the good sense and fair intent of any body of American mechanics when they are squarely met in an honest, straight-forward and business-like manner on any question with which they can be made familiar, and questions of market conditions, costs, selling expenses and profit are not complicated, although they may be made to appear so. They can be stripped of all complications, and any employer who is fit to continue in business can present them to his workmen in a form easily understood. If we would give as much time and thought to informing and educating our employees as we now spend in trying to please our customers, the effect would, I think, be helpful.

Sometimes an employer may go so far in prosperous times as to distribute a portion of his profits among his men. But it is not entirely a question of money with the American mechanic. The rapid development of business has separated him from his former contact with his employer; his imperfect notion of profits and similar matters has made him discontented.

The professional labor agitator is a logical product of the time; employers should make him unnecessary, and we shall hear no more of him. There is a reasonable and proper place for the real labor leader; one who by nature and education is fitted to counsel, advise and conciliate; who is honest, sincere and always fair; who understands business and the position of business men. This ideal labor leader, as I have described him, is a more highly idealized product of civilization than the average employer of the present time. It is expecting too much that he should materialize at once; but in time he should appear, and I believe will do so. Employers should first themselves show him the pattern in the conduct of their own business. Neither the laboring man nor his representative can be expected to advance in these matters until employers have advanced first.

I believe that there are manufacturers who are studying closely this way of dealing with labor, and are making progress along these general lines. They are not saying very much about it, and are not quite sure whether they can make a success of it. Some of them will doubtless fail to reach their ideal, and all of them will be disappointed at times; but in this, as in other matters, no honest and earnest effort entirely fails. All of us who deal with employees must expect frequently to be misunderstood and possibly abused

for trying to get into closer relations with them. It must also be admitted that some of our theories and attempts in this direction have been mistakes.

It seems to me almost, if not quite true, that the manufacturers who will achieve the highest development and success during the next ten or twenty years will be those who recognize the present conditions as temporary, and put themselves in line for permanent harmonious and cordial relations with the men who are doing for them in factory or foundry the work which they themselves would do if the size of their enterprise would permit.

With a face turned toward the bright future, and a heart full of hope, I look for that new and enlightened relationship upon which we may soon enter; a better feeling between employer and employee, a relationship most cordial, a spirit of mutual helpfulness; the prevalence of commonsense and mutual forbearance. The manufacturer with a hundred or a thousand men associated with him in the production of any kind of goods, all working harmoniously together, with intelligent united effort, and with a sincere desire of all —the owner, the lowest workman, and all the men between,—to bear a full share of responsibility, and put forth the greatest effort for the common good, is an industrial combination which will stand against the world.

The President's address was enthusiastically applauded. Secretary Moldenke then read his report as follows:

REPORT OF THE SECRETARY DR. RICHARD MOLDENKE.

It will be generally conceded that the supreme rush in our business is now over. The high point has been passed, but we have yet before us a period of steady production at fair prices. It is but natural that the coming few years will bring forth many changes in methods of running our foundries, and this feeling has been very freely reflected from the general correspondence of this office. A marked interest is taken in "continuous running" of foundries, information has been called for, advice wanted, the pros and cons argued out, all of which shows that the running of foundries night and day, and pouring continuously, may not be so far off as is sometimes imagined. It is realized that while our foundries

are now able to handle the work offered them, and that for some time to come they will probably be run below their full capacity, yet that when the next great wave of prosperity arrives, the question will rather be one of utilizing the plant capacity to the utmost, than making enlargements. It will therefore be well to ventilate this question of continuous running very thoroughly, and thus in a way prepare our membership with the necessary information in good time.

It is further generally conceded that only in educating our present and coming labor will we overcome the evils that are steadily growing and hampering the fullest development of the industry. We need better apprentices and more of them, better informed molders, and more of them; better machine hands, better pattern-makers, better core-makers, better foremen, in fact we want highly paid and valuable specialists, so to speak, in every corner of the foundry. In this way we will increase the net gain for the yearly turn-over, and not only produce better work, but make life more worth living.

To do this we must begin at the bottom. We must furnish the apprentice the means to acquire the information that is to be the foundation of his life work. The correspondence schools are doing excellent work in this direction, but not every boy can avail himself of this opportunity. How many of our boys in the foundry and girls in the core room must help to support the family, and cannot therefore acquire an education, even if they desired it. Then again, it is far better that the foreman, who must be a natural teacher to be of full value to his employers, gives the apprentice his first rudiments of the molding art. After this, and when the boy may be earning better wages, the correspondence schools will be valuable adjuncts in his career.

I would therefore recommend that short and elementary instruction papers be prepared under the direction of a special committee, and issued by this Association to our foundrymen at cost, for distribution among the employees in the foundry. The information thus disseminated would prove valuable in time. I saw an instance of this nature this winter, which demonstrated the good that can come from such a labor of love. Apprentices, molders, and even clerks from the office eagerly absorbed the information thus given by the foreman of a large foundry in the East. Not a Sunday,

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on which important repairs were made, passed without finding the students all engaged in noting cupola and other repairs, and lending a hand just for the experience it taught them, not to speak of the alertness of everyone to note mistakes that might be made by the men in the ordinary shop routine. Here was an ideal situation. A corps of men that could be drawn upon, and depended upon, in emergencies, and all willing to assist the company as part of their system of education. I may add that every one of these students is striving to become at least a foreman. Were every foundry thus constituted, we would not hear of strikes, and ordinary business capacity on the part of the management would not find it difficult to keep the shop full at all times, even at the expense of the rest of the world.

The third point I desire to bring up is the recommendation of our fellow-member, Mr. Stanley G. Flagg, Jr., who urges the Association to do something in the way of original investigation for the purpose of overcoming difficulties in foundry practice. If this be not possible, then to encourage others in doing so, by advice and financial aid. The recent endowments by Mr. Carnegie along just these lines, though more naturally for the wider field of steel, may serve as an example. We might therefore get in touch with the Universities where young men are preparing themselves for a life career, and would be only too glad to work on problems which have substantial after-results in a commercial way. The materials necessary would have to be furnished, and constant advice and conference with a special committee of our Association would constitute our end of it.

It would therefore be well to go into this question also, and see if something cannot be done of permanent value to the foundry industry.

An unusual amount of interest has been directed to the study of cast iron during the year, the direct consequence of which was the appointment of a representative committee of producers and users of cast iron. The purpose of this committee is to draw up standard specifications for testing cast iron and finished castings. This committee of 68 members, appointed jointly by the International, and the American Societies for Testing Materials, finds our Association well represented. Work is being pushed along rapidly and the results of our own investigations will be freely drawn upon.

The full significance of this departure cannot yet be fairly gauged, but it really means that cast iron has been advanced into that class of our industries which may be termed the more exact. The haphazard methods of the past are being relegated to the rear, and science and practice are combined to hold the field for much of our work formerly in great danger of drifting into the malleable and steel casting plants.

Turning now to our own affairs, we can chronicle a most active and successful year. Thanks to the generosity of the New England Foundrymen's Association, who donated $425 to our treasury, to the proceeds of the Standardizing Bureau which gave us a profit of over $350, and finally to the Philadelphia Foundrymen's Association, who voted $100 to us to cover subscriptions to the Journal for its members, we can report an unusually large amount of literature distributed, all bills paid, and a balance of $58.05 in the treasury. The income for the year was $3,175.52, and the expenses $3,117.47.

Our members and subscribers now numbers 317, and the indications point to a more rapid growth, due to the recent establishments of special sections within the Association, to facilitate the transaction of special lines of work. Much is expected from the new sections for foundry foremen and for the metallurgists. In the case of the latter, there has now been created a common ground for furnace and foundry. This has been quickly recognized, and we already count in our membership many furnace managers, and members of their official families. The work of these sections will best speak for itself.

The work of the various committees will be reported upon specially, and it only remains for me to express my personal thanks for the interest and help given me in my work for the Association. The encouragement and sound advice which I have received from my many friends in our body has been most heartily appreciated, and has indeed been the direct cause of guiding our destinies at the parting of the ways. We now have our well-defined place in the industrial economy of the world, and with the unremitting support and encouragement of our members, will maintain this place with credit to ourselves and to our country.

Respectfully submitted,

RICHARD MOLDENKE, Secretary.

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President Walker:- If there is no objection the report of the Secretary will be accepted and placed on file. The next in order will be the Treasurer's report.

Mr. Brown: Mr. President and Gentlemen of the Convention, before I submit my report, I pray your indulgence for just a moment. Last year it was my misfortune not to be able to attend the convention in Boston. It was the only one I had missed in five years. I was very much surprised after the convention was over to be advised that I was elected as Treasurer. If I had been there with you all and manifested the interest I always have felt in the Association, it would have been a sufficient honor to have been elected as your Treasurer under those circumstances; but when I was not with you and with the apparent indifference on my part you saw fit to make me treasurer, it was a compliment which touched my heart greatly. I beg to thank you for your confidence and trust displayed in me.

Mr. Brown then read his report as treasurer, which was as follows:

1902.			
June 30,	Received from Mr. West, Treas.,		$ 1.37
July 29,	Received from the Secretary	$900.00	
Aug. 31,	" " "	500.00	
Sep. 30,	" " "	682.90	
Oct. 31,	" " "	204.32	
Nov. 30,	" " "	168.67	
1903.			
Jan. 31,	" " "	295.30	
Feb. 28,	" " "	91.42	
Mar. 31,	" " "	91.59	
Apr. 30,	" " "	158.16	
May 30,	" " "	83.16	
			3,175.52
	Total receipts		$3,176.89

Disbursements:

Sundry expenses -	$ 29.06	
Printing and Stationery	85.20	
Standardizing Bureau -	99.09	
Postage - -	251.00	
Salaries - -	1,200.00	
The Journal -	1,453.12	
Total disbursements		$3,117.47
Balance on hand		59.42
		$3,176.89

President Walker: If there is no objection the treasurer's report will be accepted and placed on file. I will appoint an auditing committee later. The next in order is the report of the auditing committee.

Mr. Seaman: Mr. Chairman, I beg to say that we will report later in the session.

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President Walker: Next in order is the report of the committee of the Standardizing Bureau.

Mr. West read the report as follows:

REPORT OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION STANDARDIZING BUREAU.

Your committee begs to report that the sales of the past years have exhausted the second sample of "C" and nearly all of "B." These samples were not at once renewed, as the West Foundry Company, in making its improvements, were unable to re-arrange their small cupola, and it was furthermore not expedient to get the casting made by others on account of the special irons required, and the special method of molding, gating and pouring.

The third sample "B" was cast during April, and is now in the hands of Prof. A. W. Smith, who will have it ready for distribution very shortly. Sample "C" will be cast as soon as suitable irons to make it are obtained.

The Standards continue to grow in favor, and the Old Countries appreciate their value as well as the United States, as may be seen by the appended letter from the manager of the largest Blast Furnace in Russia (Sartana) in which he quotes the verdict of the Superintendant of the chemical laboratory.

"After three years continual use of your standards, I find them of such a great assistance, and take pleasure in recommending them as settling any disputes that arise between the blast furnace and the laboratory, and for settling misunderstandings between purchasers and manufacturers. We can only wish them the most extensive application, and we congratulate the Association with success already attained." (Signed) St. Prauss, Superintendent of Chemical Laboratory of Nicopol-Mariopol Mining and Metallurgical Co. Works.

The accounts of the Bureau up to May 25th, 1903, are as follows:

Total expenses to date	$ 806.89
Collections to date	1742.84
Bills receivable	60.72
Drillings on hand	94 pounds

Respectfully submitted,

The Committee of the Standardizing Bureau,

THOS. D. WEST, Chairman, Sharpsville, Pa.

President Walker : If there is no objection this report will be filed and the committee continued. The next in order is a report of the committee on Standard Methods of determining the constituents of cast iron.

Secretary Moldenke read the report, which was as follows :

PROGRESS REPORT ON STANDARD METHOD OF DETERMINING THE CONSTITUENTS OF CAST IRON.

Supplementing our report of last year, we beg to say that all the methods sent in by the many chemists interested were duly turned over to the new Metallurgical Section created within our Association. Its Secretary, Mr. H. E. Field, has carefully worked out a very systematic resumé of the almost endless modifications of well-known methods, and in this way presented a clear and comprehensive grouping of data upon which to work. It will now become a study of how far the reasons for elaborating the details of otherwise simple processes are founded on fact, and this will naturally take time and the practical interest of the best men in the profession.

When, therefore, the Metallurgical Section has been fully organized, work will commence along these lines, and it is to be hoped, something tangible will result. From the universal interest aroused by this undertaking here and abroad, it may be readily seen that a vast amount of good is expected, and we hope that the next report on this subject may at least show the standardization of methods for determining one or two of the elements we deal with so much in our purchases and daily work.

Respectfully submitted,

The Committee of the Standardizing Bureau

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President Walker: The next is the report of the committee on Sampling Pig Iron.

The Report was as follows.

PROGRESS REPORT ON STANDARD METHODS OF SAMPLING PIG IRON.

Your committee begs to report that the specifications for sampling pig iron submitted at the last convention for discussion, have been widely distributed, and so far have met with but one objection. This related to the use of the magnet in cleaning the sample. It seems that the even distribution of the graphite is liable to be disturbed by the too free use of the magnet, and that therefore this procedure is objected to by some chemists.

In view of the formation of an international committee on the testing of cast iron and finished castings, which embraces not only our interests as foundrymen, or buyers of pig iron, but also those of the furnaces themselves; it has been deemed best to turn over our results to the sub-committee on pig iron, of that body, so that the final methods adopted may be accepted by all parties interested, the personnel of the committee assuring this assumption.

We therefore beg that this matter of standard methods of sampling pig iron be left for a final report after the deliberations of the International committee have resulted in arranging for standards, at least so far as the American practice is concerned. We can then endorse these methods if they fit our requirements, and know that they also meet with the approval of the other interests.

Respectfully submitted,

The Committee of the Standardizing Bureau.

President Walker: If there is no objection the report will be accepted and the committee continued. The next item of business is the report on the proper valuation of pig iron for foundry purposes.

The Secretary read the report which was as follows:

PROGRESS REPORT ON THE PROPER VALUATION OF PIG IRON FOR FOUNDRY PURPOSES.

Your committee begs to report that it is a very generally accepted proposition among foundrymen that the most reliable way to test pig iron is to remelt it in the cupola and pour into regular castings. In this way any possible accidents of fracture appearance in the pig iron tried, whether they are the result of furnace troubles or the deliberate desire to make a forge iron look like a No. 1 X, are eliminated, and the founder knows just what he is getting.

On the other hand, it is also realized that unless proper methods are followed, only the best of coke is used, and everything about the trial is absolutely fair and first class, a grave injustice would be done the furnaceman.

As between the desire to test the iron by remelting, and the necessity to do this fairly, it becomes a difficult matter to specify just how to go about this. In fact one might think the whole proceeding somewhat radical, were it not for the fact that in the testing of cement the very same problem had to be encountered. Here it became a necessity that some standard sand be used to mix with the samples of cement to be examined, thus enabling experts in various parts of the world to make comparable tests. This selection of a standard sand is now being brought about, and shows that it will not be an impossibility to select a standard coke, a standard cupola, blast pressure, etc., for the testing of pig irons by remelting.

There would be, then, two things to be considered: First, the drawing up of standard specifications under which tests by remelting should be made, up to and including the preparation of the actual test bars for the comparative tests; and, secondly, the specification of the test irons, thus remelted, should be asked to pass. It is this latter point which causes your committee the difficulty, for the makers of the special grades of castings who would be only too glad to avail themselves of such a method to secure the highest grade irons for their work, are at the present time unable to assist your committee with the information necessary for this purpose.

We would, therefore, suggest that the whole subject be left an open one, and that we may be allowed to report whenever we have something tangible; suggesting in the meantime that the makers of

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rolls, furnace irons, car wheels, pipes, malleables, cylinders and other special machine castings, experiment along lines in remelting and testing best suited to their requirements, and keep your committee informed of their needs. In this way there will soon be something throwing light upon the one urgent requirement of the foundry industry tending toward a better and more uniform product.

Respectfully submitted.

The Committee of the Standardizing Bureau.

President Walker : Next will be the report of the committee on Insuring Patterns.

The following report was read by the Secretary :

PROGRESS REPORT OF COMMITTEE ON INSURING PATTERNS.

Your committee begs to report that owing to the crowded condition of the foundry industry but little more than preliminary work could be done during the past year. Pursuant to the authority vested in the Chairman by the last convention, the committee was enlarged by the addition of the following names: Messrs. C. J. Wolff, Chicago, Ill.; Thos. D West, Sharpsville, Pa.; S. H. Stupakoff, Pittsburg, Pa.; Richard Moldenke, New York.

The Insurance Interests, as represented by the National Board of Underwriters have been very cordial in their dealings with your committee, everything pointing to a complete and equitable solution of the problem, thus assuring our foundrymen on the one hand prompter adjustment in case of losses, and the Insurance Interest, on the other, a tangible basis upon which these adjustments can be properly and fairly made.

We will report from time to time, as the details are settled, in the columns of our Journal, and it is hoped, will be in position to ask final action by the Association at the next convention.

Respectfully submitted

The Committee on Insuring Patterns.

F. CONLIN, Chairman.

President Walker : Next will be the report on the Foundry Trade School.

Mr. Seaman : Gentlemen, I am sorry to say that I cannot report anything further than progress. As this Association well knows a school has been determined upon that will be established in Pittsburg by Andrew Carnegie. Your committee had the intention of investigating the matter thoroughly and ascertaining what the views were of the parties who had the matter in charge. We have been unfortunate in Pittsburg—been peculiarly situated. We have the money there to build that school; we have the money there to buy the ground to put it on, but we lack something, we are not going ahead. Politics has had considerable to do with the matter. The money for the school was donated some three years ago; there were bonds issued by the city and a vote of the city taken to buy the ground. Unfortunately, the bond issue was for purchasing ground for park purposes. After it had passed, it was found that the city had no authority to divert that money to buy grounds for this school which was intended to be part of the park. We went into the legislature last fall and had a special act passed so that we could divert that ground for the purpose desired. We have got that far on. The parties opposing this are now questioning the constitutionality of this act of the legislature. The last report was that those opposing it insisted upon having an understanding of what that school is going to be and what they are going to teach and who was going to have the benefit of it and who was not. We have had all kinds of trouble regarding this school, so we will report progress. I hope something will come up by the time of our next meeting.

President Walker : If there is no objection this report of progress will be filed and the committee continued.

Secretary Moldenke : We have not completed the program yet. There would be in order a discussion of the points brought out in the President's address and the Secretary's report in regard to the position of the Association on the question of instruction papers for our foundry apprentices. I will say in connection with my report that the foundry I mentioned is that of the American Locomotive Works in Schenectady. I met our Mr. Ramp, the foundry superintendent, there and was much pleased to learn that

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these little papers relating to foundry questions were being read and studied by the boys in the evening. I could see that if you could get all the boys, all the molders, all the clerks in the office, in fact everybody that has anything to do with the foundry, to learn what is going on in the foundry, that in time of emergency your men will all stand by you. It has occurred to our president and to myself, that if the Association would do something in the way of appointing a committee to draw up a lot of instruction papers and make them available to foundrymen to give out among their men, to help instruct them in the management of the foundry, it would help to bring up in our business a class of men who not only pound sand, but who would have a much better knowledge of the business. I read a few weeks ago in the New York Mail and Express a little editorial in which was stated that if all the industries of this country would do what the American Foundrymen's Association is doing for the foundry interest, in the way of educating its workmen and apprentices, the country would thrive wonderfully. If there can be some discussion of the subject and some motion made for the appointment of a committee in this line I feel there is a splendid field here for our industry.

Mr. Spence: I was very much pleased with the address by the President of the Association. I would like to see the address of the president in pamphlet form and put in the hands of every workman in the United States, who is intelligent and a thinking man. The key-note to success in this or any other branch of manufacturing is the education of the young men. Teach the man to think. Let him feel that he who is giving him employment is just as beneficial to himself as to him. There were many beautiful thoughts in the address of the president and I just wished while I sat here listening, that if this address could be taken right into the heart of every workman in the United States and if he could feel within himself what is in the heads and hearts of the manufacturers of the United States, how much better our conditions would be. There would be fewer strikes, less agitation, and better feeling. We want men to think that we are living one for another, that in a few days or in a few years, some of the men that are sitting around here will have to pass away and they will be beyond the land of strife and agitation, and manufacturies We want bright and brilliant young men,

thinking men, and men who have character and feel that this is worth more than anything else. That is what we want in these days of strife and agitation. I would that this address could be published and that every foreman and every superintendent would place that in the hands of every man under his charge.

Mr. West : Mr. Chairman I regret exceedingly that I was not here to hear your address. I know it is on a subject in which everyone is interested. The question of trade schools is one that I have taken a great deal of interest in and did much work along this line. As was known in our last meeting, I had gone as far as my own efforts would allow me. For that reason I was glad to see it turned over to Mr. Seaman's committee which is closely in touch with Pittsburg's leading men. I believe with such an institution as we have in mind in the Carnegie Endowment that we can bring up men who will thoroughly understand the principles of thier trade and can replace any man and see that the work is done properly. We do not want to be placed at the mercy of agitators and shop committees and all that sort of thing. I sometimes feel that the men who have got their money in and established a busines that they are at the mercy of some foreman or some committee-man, that they are taken advantage of because they know nothing themselves about the trade.

I want to see this work go on on practical lines and hope the people in Pittsburg can give us something.

Secretary Moldenke urged the appointment of a committee to encourage experiments along foundry lines by young men in universities. He moved that the president appoint a committee to take this question in hand and that Mr. Flagg be made chairman of the committee.

The motion was seconded and carried.

President Walker: Gentlemen, if there is no objection and Mr. West is willing in order to save time in the afternoon session, we will take up his address on "A Cupola Slagg Conveyor."

Mr. West then read his paper which is given in Part I. of the Journal.

President Walker: This concludes the business scheduled for the morning.

The convention then took a recess until 2 P. M.

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TUESDAY, JUNE 9. Afternoon Session.

President Walker called the convention to order at 2:30 and appointed the following committee on nominations:

Messrs. William Yagle, Pittsburg; John Magee, Boston: J. P. Golden, Columbus Georgia; A. W. Bair, Milwauke, Wisconsin; T. J. Best, Montreal Canada.

The president appointed the following auditing committee: J. S. Seaman, William Yagle, S. H. Stupekoff.

President Walker: The next in order will be an address by Mr. Jos. Leon Gobeille Patterns, President of the Gobeille Pattern Company, Cleveland, Ohio, on "The Organization, Maintenance, and Management of a Modern Pattern Shop.

I have the pleasure of introducing Mr. Gobeille.

Mr. Gobeille then delivered his adress, illustrating it by models, photographs and charts. The address is given in Part I. of our Journal, and the discussion thereon turned the end of these proceedings.

On motion of Mr. Seaman, a vote of thanks was tendered Mr. Gobeille for his instructive paper and discussion.

The President then asked Mr. A. M. Loudon, the chairman of the Foremen's Section to preside.

ADDRESS OF MR. A. M. LOUDON.

Members of the American Foundrymen's Association and the Sections connected with same: In taking the chair on this occasion I wish to express my appreciation of the honor it involves.

On behalf of the Foundry Foremen present I desire to call attention to the advantages which should accrue to shop proprietors by having their foremen improve themselves through an exchange of ideas as to how practical foundry work may best be carried on.

In days gone by, the owner of a foundry was generally a man who had worked himself up from the bottom and who was therefore intimately acquainted with most of the details connected with the trade. It was nothing uncommon for him to pull off his coat and set the days work on a job, or show a molder how he could handle himself to better advantage. With larger shop organization

this type of proprietor has passed awny and today the larger foundries depend mostly upon foremen to see that they are operated to the best advantage.

It is important to them then that their foremen shall have a broad knowledge and nothing will promote this to a greater degree than to meet others holding similar positions and honestly discussing ways and means by which shop difficulties may be overcome and methods in vogue improved. The man who stays in one shop year after year, without being afforded a chance to learn what his neighbors are accomplishing, soon has his mind traveling in a narrow groove, hurtful to himself as well as the concern who employs him.

I feel that I may well ask the employers to encourage their foremen to affiliate with the American Foundrymen's Association. Our aim is to improve ourselves, and in doing so we cannot fail to benefit those over whose shops we preside, and who look to us to keep them on a dividend paying basis. More than one foundryman may believe that he has the smartest foreman on earth, and the foreman himself may share in this belief, yet it is a fact that all of us need to learn more in one particular or another.

A foreman, to be competent today, has to know more than he ever did before. His employer may furnish the very best of equipment, but it requires a trained head to utilize this before it can be made to yield the greatest returns. The foundry owner at the present time, as a rule, has all he can do to attend to the commercial end of the business without adding to his care the time required to give attention to shop details. Therefore, any assistance he lends his foundry foreman to keep up with the time, makes the manufacturing end of his business all the more effective.

PROCEEDINGS OF THE FOREMEN'S SECTION.

Mr. Loudon : The first paper will be by A. W. Walker, of Boston, on the subject, "A Simple Device for Ascertaining the Average Silicon in an Iron Mixture."

Mr. Walker then addressed the assemblage on this subject explaining his method of calculating iron mixtures with the aid of the instrument he had gotten up specially for the purpose.

During the following two days he was kept busy explaining the

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instrument to individual members who were exceedingly interested.

The paper is given in Part I, of the Journal.

Mr. James A. Murphy, of Erie, Pa., next read his paper on "Permanent Moulds :" (See Part I. of Journal.)

Mr. Edward Gilmore of Peoria, Ill., followed with his paper on "Molding Machines." (See Part I. of Journal.)

Mr. Knight asked Mr. Gilmore if he preferred the use of a stripping plate machine to a squeezer in all cases and whether his experience had been that a conveyor cheapened the cost of his work. Mr. Gilmore said that they could not always use the squeezer. Different places had different results. In small patterns he preferred the squeezers because they got better results; when the patterns are complicated in the least degree they could not possibly use a squeezer to advantage. In that case he would not adopt the squeezer. Mr. Gilmore said he favored the use of conveyors as it made it unnecessary for the men to travel so far.

Mr. S. H. Stupekoff of Pittsburg, Pa., then read a paper on "Molding Machines" (Part I. Journal)

The discussion is given separately later on.

Mr. Loudon next read his paper on the Trials of a Foundry Foreman (Part I) which completed the list of papers for this session. The waste coke was next taken up.

DISCUSSION ON WASTE COKE.

Mr. Best stated that he had secured good results by mixing the waste coke with the coal and putting it in the cupola.

Mr. West said they used all their waste coke for black-smith fires.

Mr. Gilmore said that more of this waste coke could be used in the big foundries than in the smaller ones. To use it in the cupola is liable to clog it up.

One menber said that they disposed of it to families for domestic use in their stoves.

Mr. Stupekoff suggested that it might be made into brickettes and used for fuel.

Another member thought this method would prove too expensive in this country, but might be operated successfully in Europe.

Another member said they used a good deal of waste coke to bank their fires with, especially Saturday nights.

Chairman Loudon announced that the programme for the Foremen's Section was now complete, and asked President Walker to resume the chair.

President Walker took the chair. He urged the members to be prompt in attendance at the evening session, which was to commence at eight o'clock.

Thereupon the association adjourned to meet at eight o'clock.

TUESDAY, JUNE 9. Evening Session.

The meeting was called to order at 8 P. M.

President Walker stated that the first paper to be read was on the subject of "Retort Oven Coke for Foundry Use" by Mr. Wm. J. Keep. At Mr. Keep's request the paper was read by Mr. Blauvelt. (Part I.)

The paper was discussed at length. See end of the Pamphlet.

Mr. S. H. Stupekoff then read his paper, on "Employers and Employees," which was well received. (Part I)

President Walker: The next paper this evening is on "Heating and Ventilating Foundries and Machine Shops," an illustrated lecture, by Mr. W. H. Carrier of the Buffalo Forge Co.

Mr. Carrier illustrated his remarks on the above subject by means of lantern-slide pictures showing the various installations discussed. (Part I.)

President Walker said that owing to the lateness of the hour there would be no discussion of the paper.

Mr. S. S. Knight, Manager of the Birmingham Pipe & Casting Co. of Birmingham, Ala., then delivered an illustrated lecture on "The Principal Factors of the Iron Industry in the Birmingham District." (Part I.)

The association then adjourned until 9:30 next morning, at which time the secretary stated the Metallurgical Section of the Association would hold its session.

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WEDNESDAY, JUNE 10. Morning Session.

METALLURGICAL SECTION.

President Walker called the convention to order at 9:30, and turned over the chair to Mr. Flintermann, of the Metallurgical Section.

Dr. Moldenke: Perhaps I might open the discussion with some explanatory remarks. I wish to say that Mr. Field, as secretary of this section, has performed a great labor in getting together all the various methods you see in the reports. From what I have heard mentioned about the matter the chemists of this country and in Europe are very much interested in seeing such a systematic compilation. It is not only a compilation of these methods, but I might say a living example of the peculiar way in which the minds of chemists run on details. Mr. Field mentions a few matters in which standardizing could be profitably attempted.

The discussion this morning, I suppose, would be better brought into the line of how we could best take up these numerous variations of given methods, and by forming suitable committees of chemists, who will take up the experimental work on the lines laid down and properly digest them. This might lead to wiping out a lot of variations as unnecessary. If in this discussion that line of argument leading to practical results be taken up, much good would result. We know that chemists all over the world have been trying to get together on standardizing methods. The nearest approach to this was made by Dr. Dudley, of Altoona. The American Foundrymen's Association is situated very peculiarly. Chemists among themselves as a rule cannot agree. One will say, "My method is better." But coming from the American Foundrymen's Association—from foundrymen who want results, who want facts—who want to know when they buy from the blast furnace, whether they get the right thing. A method once adopted by it could be certain to be used generally. Now if the chemists of these two interests can get together, much good can be accomplished. There are business interests behind this thing that will stand behind the chemists of the two interests.

Chairman Flintermann: I think Mr. Field had some suggestions.

Mr. Field: It was thought best that this matter could be handled by a committee. It is going to be a difficult problem to get all of the chemists interested. We must get men out of the various sections of the country to take hold of this matter. Naturally, you've got to have the co-operation of every chemist in the blast foundry business in order to make it a success. It was my idea that the chairman of the section, with the help of a committee, should have general oversight of this matter of standardizing methods. It is a matter beyond the power of one man unless he takes all his time.

I move that the chairman of the section appoint such a committee of five and be given time until the final session to make such appointment. Motion carried.

Chairman Flintermann: I think this subject would be too large a one to take up. It might be well to leave it to the committee, and for the present we will pass over it. We will now take up the papers—First, the one presented by W. E. Dickson, "Loss of Sulphur in Borings of Cast Iron."

Mr. Field then gave a synopsis of the paper. (See Part I.)

Chairman Flintermann: If there is no more discussion on this subject we will go on to the next paper, "Notes on the Microstructure of Cast Iron," by Percy Longmuir, of Sheffield, England. The paper is very interestingly gotten up, and if there is anybody here sufficiently interested to have a discussion on it I would be glad to read it. I think most of us will have to take it home in our closets and study it over. It certainly has been carried to a fascinating point in steel.

Dr. Moldenke: I would like to add in connection with this paper, that yesterday, you know that, there was a committee appointed with Mr. Flagg as chairman, to go into the question of encouraging original research. One matter Mr. Flagg gave me at the time was the microscopical study of cast iron. If Mr. Flagg can succeed in getting this committee to do anything and raise a fund, it is possible this association might aid in the way of samples, etc.

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Chairman Flintermann : I would like to ask the Doctor if there is any work published that gives results of research along the same line on malleable iron ?

Dr. Moldenke : I think there was some work done by Prof. Howe, at Columbia, on this subject. Perhaps Mr. Flagg can give us some information.

Mr. Flagg : There has been one paper published by Mr. Stead, in the transactions of the Cleveland Association of Engineers. I would suggest that you write Prof. Sauveur, of Boston.

Chairman Flintermann : There is one paper not down on the program, by Mr. A. W. Slocum, "Analysis as a Help to Mixing Iron.'

The paper was read by Dr. Moldenke. (See Part I.)

Mr. Field : Mr. Chairman, I believe you were going to recommend a presiding officer for this section during the coming year.

Dr. Moldenke : As the constitution does not provide for these sections yet, I would suggest when you name a chairman for the section that the nominating committee be given his name for presentation to the convention for endorsement.

Chairman Flintermann : You have heard the recommendation that we appoint a chairman for the next year. What is your pleasure ?

Mr. Field : I nominate Mr. W. G. Scott for chairman of the section.

Dr. Moldenke : I would like to nominate for the secretary Mr. Field, because Mr. Field has been of great assistance to me during the year. There is also a movement in the nominating committee to recommend him as assistant secretary to the association at large.

The nominations were seconded.

Chairman Flintermann : It is moved and seconded that Mr. Scott be recommended to the nominating committee as chairman of the Metallurgical Section and that Mr. Field be recommended as secretary.

The motion was put and carried.

A recess was taken for 30 minutes

Chairman Flintermann called the meeting to order at the end of the recess.

The paper by W. Walley Davis, of Roanoke, Virginia, on "Blast Furnace Conditions Affecting the Chemical Composition of Foundry Iron," was then read. (See Part I.)

Chairman Flintermann: You have heard the paper. Probably a great many here have their own ideas upon this subject and would like to add something further. The paper is open for discussion.

Mr. West: There is one point I would like to bring out here—in regard to the physical structure of iron. I have had it claimed lately to me by a prominent furnaceman that he could regulate the working of a furnace so as to give any structure in the iron desired. It is the first time I ever heard such a claim made. I know that the variations in the physical structure are largely due to the temperature at which the iron comes out of the furnace and the time it takes the pigs to cool. I would like to hear other views upon that point as to what the members think of the practicability of such a claim.

Mr. Field: We were very anxious to get this paper. It is our desire to get our furnace friends on record as much as possible. Mr. Davis has very kindly done this. It is something that none of the other blast furnace men would do. I think he deserves the special thanks of our Association for this.

Chairman Flintermann: Mr. Field we would like to hear your paper.

Mr. Field then read his paper on "Buying of Pig Iron on Specifications." (See Part I. of Journal.)

Chairman Flintermann: Gentlemen, the paper is open for discussion.

Dr. Moldenke: One point that Mr. Field has not touched on there; that is, he speaks about contracting for a given reduction in case the iron does not meet specifications. There should be another clause there that the furnace gets a certain bonus for giving better iron than has been called for. The paper is very timely and of course one that has to be thought of very carefully before we go further, but at the same time one that should be discussed.

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Mr Scott related his experience in selling iron under specifications when the market was changing. He said it was difficult to buy iron under specifications when the market was advancing, but not difficult when the market was dropping. He said it was possible to pick up lots of iron that did not come up to specifications and use it to supply certain trades where it was well suited.

Dr. Moldenke said he had had a similar experience.

Chairman Flintermann then introduced Prof. Peter A. Kozmin, of St. Petersburg, who addressed the assemblage as follows :

ADDRESS OF PROF. KOZMIN, OF THE UNIVERSITY OF ST. PETERSBURG, RUSSIA.

Gentlemen: I am indeed delighted to be present at this gathering of the representative foundrymen of the United States. Before I left my own country I had already known something of the industries of America from its literature, but literature does not give one-tenth the information to be obtained by actual observation. I have been in your country only five months, but in that time have learned more than I could have done in Russia in five years.

The European Engineers have a saying that they discovered American in 1876, at the Philadelphia Exposition. Since then they have rediscovered it in 1893 in Chicago. and now hold that the industries of the United States are the foremost of the world.

Formerly we thought that only Switzerland could make watches, but in 1893 we saw that the United States made watches better and twice as rapidly as over there. If, formerly, we thought that England and Germany made the best machinery, we think differently now. And here let me quote the words of the famous European Technologist, Sir George Whitehouse, manager and chief engineer of the Uganda Rail Road, after he had returned to London. "We have 36 American and 34 British main line engines. The experiment with the American locomotives proved entirely satisfactory. They are 10 per cent. cheaper, and are more suitable for a mountain railway like the Uganda road. Of the steel viaducts along the line 26 are of American and 8 of British make. The American viaducts are excellent."

After Prof. Riedler, the famous German Technologist had re-

turned from the Chicago Exposition he said, "The United States is a country which is too large, too wealthy, too young, and works too quickly and too well." Gentlemen, let me be bold and correct Prof. Riedler's statement. Wealth and youth are things of which we cannot have too much. I would like to see the United States richer, working quicker (if this were possible) and always young. Youth has ever been a source of energy, strength and success.

Now gentlemen, let me finally say that Russia buys annually 600,000 tons of machinery from Germany, England, Switzerland and France. She gets but little from the United States. This import into Russia is growing yearly, and I would like to see most of it come from here.

At the close of his address a vote of thanks was tendered Prof. Kozmin.

Chairman Flintermann : I think this completes the work laid out for the Metallurgical Section today. I hope that this, the first year of our undertaking, will give promise of further and more extensive work for another year. I hope that all who are interested in the Metallurgical side of foundry work will do all in their power to help the movement along. I think it will be well worth their while. One thing in connection with the metallurgical section—we could carry out the programme that has been outlined, namely, to publish in connection with the Journal a review of all articles that come out in the various journals relating to the metallurgy of cast iron. It is impossible for any one to see and read all of these journals. It might be a good scheme, for instance, to develop this work by a special committee. We would then get an outline of these articles and know where we can find anything that would interest us.

The convention then adjourned until 10 a. m. the next day.

THURSDAY, JULY 11. Morning Session.

The convention was called to order at 11 A. M. by President Walker.

President Walker: Mr. Field has an announcement to make.

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Mr. Field : The matter of instruction papers mentioned in our meeting the other day has been somewhat discussed. It seems the sense of the association that something should be done about this matter, and I therefore move that action be taken to that effect.

The motion was seconded and carried.

President Walker: Gentlemen, I have not heard whether any progress has been made in the matter of the separate sections of Pattern Foremen and Foundry Accountants. It may be that something might be said at this time, but if not I would like to have the matter kept in mind for another year. I should, however, be glad to hear any remarks.

Secretary Moldenke : In connection with this subject I desire to say that the pattern makers seem well pleased with the idea, but there seems to be a lack of initiative; someone to take the chairmanship of such a section. I think if we can find some one to do this, the Pattern Foremen's Section will be assured. The idea is to get in touch with the pattern foremen and arrange for a number of papers in connection with the pattern maker's work.

President Walker : The next item of unfinished business is the report of the Auditing Committee.

Mr. Seaman : I would say that we have gone over the books of the last year and we find them correct. This has been certified to by the three members of the committee.

President Walker : If there is no objection the report of the auditing committee will be accepted.

Secretary Moldenke : Mr. President, we would like to do all we can to get new members into the association, and if any one hears of those desiring to join I would be very much obliged if they would give me the names. In this connection I think some action might be taken in regard to the associations that would be elligible to come in to our membership at the $5.00 rate. I notice there are springing up all over the country foundrymen's associations dealing with local conditions that might be induced to join us under this class.

Mr. Sheriffs : A great many have asked me "who were the American Foundrymen's Association," I could not give them any information. If there were something in the shape of a pamphlet giving the members of the association and the dues and it was forwarded to the secretary of each of these local associations they could distribute to each member at a very small amount of trouble.

Secretary Moldenke : I will say in that connection that I have run across the same thing a number of times. I think the last list of members published by this association was back in 1897. I have now in the hands of the printer the beginning of a pamphlet giving a full list of members, the constitution, statistics, the honorary members, etc. As soon as I get back home I am going to get this matter into shape for early distribution.

Mr. Seaman : In connection with what is being discussed here I think there is a little advantage in the way we are working in Pittsburg. We have a foundry association there that is quite strong. The dues for our local organization pay the dues in the American. We charge each member $10.00 for an initiation fee and then the dues are ten dollars a year, five of which go to the American Foundrymen's Association. In this way every member of our local association is a member of this and it works very nicely. I think the Pittsburg association was the first to adopt this procedure.

Mr. Sheriffs : Our dues at Milwaukee are $5.00 and fifty cents a month, payable quarterly.

Mr. Seaman : The advantage of the Pittsburg Association is, the members say, that they get all the printed matter that the American Association gets out.

President Walker : I will appoint the committee provided for in the motion of Mr. Field. Mr. Field is made chairman with authority to add the other members.

Mr. Brown, of Erie : I owe the members an apology for not getting a matter I wish to discuss into shape and sent on for reading along with the other papers. I was very busy, and as I get older I find I don't try to cross bridges until I get to them. I have had a little pet scheme in mind for something over year. I have talked to the Secretary about it once or twice, but our meetings

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were so infrequent that I could not get time to digest it properly and I thought I would bring it before the meeting at this time and see what you all think about it.

ADDRESS OF MR. WILLIS BROWN

Gentlemen, for some time I have believed that our Journal should be published at regular intervals, say quarterly, if you please, for several good reasons. First, the cost of distribution will be less as it can be mailed as second class matter. Then again members will soon get to looking for its arrival, and it will be expected and be the more welcome on that account. Further, it will be more handy to file and to refer to, and all papers as now published can be published in the Journal and by the regular publication idea an opportunity will be afforded for short articles and inquiries and answers on important subjects which do not require space enough for a separately printed article, and in this manner the interest in the Journal will be much increased.

In addition to the above matter other departments can be established wherein the various interests of the foundrymen and the foundry foremen can be considered. Among these I beg to mention incidentally that it might be possible to establish a department of analyses, in which all analyses of irons and cokes, if you please, made or sold in the United States may be entered. These analyses can be published as furnished by the furnaces or by the members from such analyses as they obtain or in any other way which is considered practical. You can readily see that in time the Journal would be a most valuable aid in the foundryman's office or in the office of the foundry foreman, and would be more carefully preserved than possible at present. In this connection I beg to refer to the book published by Mr. Church, of California, a copy of which I presume many of you have, and a copy of which I have with me for inspection.

I believe our Journal, if published as suggested, would soon become a vehicle of more valuable and trust-worthy information in relation to analyses of irons than any other publication in the United States, for the analyses and statements therein would pass under the critical inspection of practical men who would be capable of

dissecting them and pointing out the defects where such existed.

Again there might be published a sort of cook book department in which the foundrymen so disposed might publish their mixtures and results.

Permit me to say further that interesting articles and opinions could be published concerning almost any material which enters into foundry practice, and which cannot well be published by the regular trade journals for obvious reasons. Of course it would be understood that membership in the Association would carry with it the subscription to the Journal which of itself would be worth many times over the cost of the membership, and would, I am inclined to believe, secure some members who would not otherwise unite with us.

Referring to the question of membership I beg the privilege of digressing just a little. A couple of years ago we used to hear considerable questions about the wisdom or propriety of opening the doors of the Association to that part of our community known as "The Trade." Now I have a lurking suspicion that the American Foundrymen's Association owes much of its success to "The Trade" and for one small unit in the Association I say open the door good and wide to "The Trade" and write a good big "Welcome!" over the door. Not only to the trade would I open our membership but I would open it to any respectable citizen of the United States who might think well enough of us to apply for admission. Why not? If he is sufficiently interested in the foundry business and our Association to come in and pay his share, why not let him? What damage can he do the Association? Do you fear that the tail may wag the dog? Well no, let's build up a great big liberal open door Association of one thousand members and publish a Journal that will make it a necessity to every foundryman in the United States to become a member thereof.

In conclusion I would like to put the following to vote:

Resolved, That a committee consisting of the President, the Secretary and three other members to be appointed by the President, whose duty it shall be at as early a date as possible to perfect plans for the publication of the Journal of the American Foundrymen's Association regularly, either quarterly or bi-monthly.

The motion was seconded and carried.

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Mr. Loudon : Mr. President and gentlemen of the convention, as the retiring president of the Foremen's Section I want to take this opportunity to extend the thanks of our section to the executive officers and members of the American Foundrymen's Association for their great liberality in opening up the door and admitting the foundry foremen to affiliation with it as a body. I am convinced from the feeling that is exhibited at the convention this year that the American Foundrymen's Association will be in the position of having at least fifty foundry foremen added as members of this association. This is about all I can touch upon now, but before retiring I would like to present to this association the president, vice-president and the secretary of the Foremen's Section for the ensuing year, Mr. Thomas, Mr. Gilmore and Mr. Murphy.

Secretary Moldenke : I have received a letter from Mr. Morehouse, one of our members, in which he makes a suggestion which would emphasize what Mr. Brown says, that is, he would like to have his Journals bound. Now, I have had a number of calls from different libraries and it might be possible to do something in that line. If the binding should not be elaborate possibly 50 cents would do it, but if elaborate probably $1.00 per volume. If there is any great sentiment in that direction I would have them bound for those who apply at a stated reasonable charge.

Mr. Brown : Referring back to the article that I read there in the resolution—I would really like to get some expression of opinion, of ideas, from the members present as to what they think of that idea. I don't want to have a resolution passed there and carried unanimously out of courtesy of anything like that. If the ideas presented do not seem right I would like to have the members be frank enough to say so, and if they do feel that is a move in the right direction an expression of that kind would aid the committee in the matter of moral support anyway in what they adopted today.

Mr. Gilmore : Some time ago the secretary sent out a notice to every member wanting to get the methods for the determination of the constituents of iron as used. That has been carried on nicely. I have received notice regularly of the different methods in vogue. I would like to suggest that there should be a separate

volume of the results of the work of the committee of which Mr. Field has charge.

A regular publication as Mr. Brown suggests would mean a good deal of labor. We would have to have a staff to look after the separate portions of this work. But I am nevertheless heartily in favor of what Mr. Brown says if we can see some way to get through. The moment we get after advertisements we run against a not particularly friendly feeling of the trade papers. The proper idea would be to have the committee go over that with the president and secretary and see what can be done. I have been thinking about what has been suggested many times during the year and Mr. Brown can feel that a great many of the members of the association are with him in this thing. I for one would be very glad to see his ideas take shape and be carried out.

Mr. Brown : I did not contemplate any greater expense in the new idea than in the old—simply to make the publication four times a year instead of at haphazard. I had not contemplated any editorial work. I thought if we could publish the Journal regularly every three months, or at other regular intervals, it would not cost any more to do it than at present. Now, in the matter of editorial work that would be a matter for the committee.

Secretary Moldenke : I want to say in regard to the present publication, as far as I have been in it, that I have tried to follow the example of the great engineering bodies—to get the information to the members as fast as I could get hold of it.

Now Mr. President and gentlemen, I would like to bring before you another matter for your consideration. This association is about as well known in Europe as it is in America, and I think it would add credit to ourselves and to the industry of the country at large if we selected some gentlemen from Europe for honorary membership in our association, and I would like to propose that we elect Prof. Thos. Turner, the father of the revolution in the foundry, as he was the first man to bring out the relation of silicon to iron—Prof. Thomas Turner, of the University of Birmingham, England; and Prof. A. Ledebur, of the Royal Mining School of Freiberg in Saxony, the most famous German authority on Cast Iron, as honorary members.

The motion was seconded and carried.

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Secretary Moldenke: I received a letter from Mr. Howard Evans, Seeretary of the Philadelphia Foundry Association, in which he says the following:

Philadelphia, Pa., June 4, '03.

Dr. Richard Moldenke, Sect'y.

Dear Sir:—Prof. Jos. Holmes, who represents the St. Louis Exposition appeared before the meeting of this Association last evening and wants us to assist him to organize a Foundry Plant and run it at the St. Louis Exposition 1904. The following committee was appointed by the president, Thos. Devlin: A. E. Outerbridge, Chairman; Geo. C. Davis, Chemist; and E. E. Brown, Foundryman; and Thos. Devlin, President; and Howard Evans, Secretary, Ex-Officio.

The above Committee are to confer with American Foundrymen's Association, also National Foundrymen's Association, the idea being to establish such a plant. Dr. Engler, of the Worcester Polytechnic Institute, offered to supply a mechanic as a superintendent of the above foundry. The Exposition people will provide the grounds and building; Foundry Supply people will no doubt be glad to furnish everything that will be wanted, and take in payment the advertisement that may accrue.

Under these circumstances, the Foundry Plant at the St. Louis Exposition seems to be feasible. I take the liberty of addressing you at this time, in advance of any definite plans that might be developed later on by the committee, for the reason you may present the subject if you see fit, before the Convention at Milwaukee.

Prof. Holmes said he would write you as I gave him your address. Trusting this may be understood and acceptable, and with best wishes, I remain, Yours truly,

HOWARD EVANS, Secty.

Secretary Moldenke moved that the communication be referred to the executive board.

The motion was seconded and carried.

Secretary Moldenke: I now have to present, gentlemen, the question of the next meeting place of our association.

The secretary read a communication from the Iron and Machinery World on the subject, also invitations from officials of the St. Louis World's Fair and the local Foundrymen's Association for the American Foundrymen's Association to hold its next meeting in St. Louis.

Secretary Moldenke said he also heard indirectly that an invitation would be given by the Foundrymen's Association of Indianapolis to have the convention there.

President Walker : I presume this will be referred to the executive board with power. Any remarks ?

Mr. Seaman expressed the opinion that Indianapolis would be a more desirable place to hold the next meeting than St. Louis, owing to the attractions of the Fair which would draw the members away from the sessions of the convention.

Mr. Best : I move that the letters be answered and thanks extended for the invitations.

President Walker : It has been moved and seconded that we acknowledge with thanks the receipt of the communications from St. Louis with the statement that the matter is under consideration.

The motion was carried.

President Walker : Is there any further business ?

A Member : I would like to hear from the new president of the Foremen's Section.

Mr. Thomas : I can only say that I am more than pleased with the action taken by the A. F. A. in extending the courtesy they have to the foremen to affiliate with them, and hope next year will be one of great gain to the foundrymen's business, as the foremen's interests in this are identical with the employer. We sincerely hope that the relation between the two may become closer and that the foremen will receive the encouragement they deserve. I believe if the foreman will make a confident of his employer when things go wrong and not go ahead and try to cover up one blunder with another it will be better for him. The foreman must be competent; if not, he should be replaced by another.

It is our desire to try to educate the foremen up to the highest possible point and with the hearty co-operation of the A. F. A. we hope to accomplish this.

President Walker: The report of the nominating committee for officers for the ensuing year will be in order.

The nominating committee made a report, recommending the following as officers of the association for the coming year:

For President—Willis Brown, Walker Foundry Co., Erie, Pa.

For Vice Presidents—1st District, John Magee, Magee Furnace Company, Chelsea, Mass.; 2nd District, J. A. Beckett, W. A. Wood M. & R. Mach. Co., Hoosic Falls, N. Y.; 3rd District, John McClaren, Phillips & McClaren, Pittsburg, Pa.; 4th District, A. K. Beckwith, Estate of P. B. Beckwith, Dowagiac, Mich.; 5th District, C. J. Wolff, S. Wolff Mfg. Co., Chicago, Ill.; 6th District, Adam W. Bair, C. M. & St. P. F'ds, Milwaukee, Wis.; 7th District, J. P. Golden, Golden's F'dry & Mach. Co., Columbus, Ga.; 8th District, T. J. Best, Warden, King & Company, Montreal, P. Q.

For Secretary and for Treasurer—Dr. Richard Moldenke, New York City.

The following nomination was recommended to the Executive Board for comfirmation, there being no constitutional provision for the officers in question.

For Assistant Secretary to the Association—H. E. Field, Ansonia, Conn.

For Chairman of the Foundry Foreman's Section—Chas. H. Thomas, Hay Foundry and Iron Works, Newark, N. J.

For Secretary of the Foundry Foreman's Section—Jas. A. Murphy, Bell Engine Foundry, Erie, Penn.

For Chairman of the Metallurgical Section—W. G. Scott, J. I. Case F. M. Co., Racine, Wis.

For Secretary of the Metallurgical Section—H E. Field, Farrel Foundry and Mach. Co.; Ansonia, Conn.

It was moved and seconded that the secretary cast the vote of the association for the officers nominated.

The motion was carried and the secretary cast the ballot for the nominees and they were declared elected.

President Walker: Mr. Brown, I have the pleasure to an-

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nounce to you that you are elected president of this association. Do you accept this honored office?

Mr. Brown: Mr. President, I would be very unfeeling if I did not accept it, and I want to say in accepting it I want to return more thanks than I can express for this manifestation of your confidence in me. I shall undertake the duties with more or less fear, as it requires a good deal of time, a good many difficulties to overcome to successfully manage an association of this kind, with a diversity of interests, and about the only hope that I could have in going into it with any idea of coming out of it successfully is the fact that Dr. Moldenke is the secretary. With his efficient services it leaves much less to the executive than otherwise.

It is especially a pleasure to me to serve as president the coming year by reason of the fact that at one time I lived in St. Louis and had many acquaintances there. I have been known in St. Louis for thirty years. It will give me much pleasure to take up this matter of convention in St. Louis. As a general proposition I quite agree with Mr. Seaman to hold our sessions in St. Louis is somewhat questionable, but possibly we can arrange for our accommodation there.

I believe that every member of the present organization should constitute himself an individual committee of one to see if he could not get in some neighboring foundryman. The results would be very perceptible in a short time. Gentlemen, I thank you.

Secretary Moldenke: I thank you also for the courtesy in electing me to the secretaryship, and I will say, as I did last year, I will do even more this year than I did last if at all possible.

Mr. Seaman: As we are near the closing hour I think it is no more than proper that we should take into consideration what our officers have done during the past year—the retiring officers. We fully realize that this has been the most successful convention we have held, all of which is attributable to our efficient officers. That being the case I respectfully offer a motion that we return a vote of thanks to our retiring president and that we place his name on the roll of honorary membership.

The motion was seconded and put by Pres. Brown and carried.

Mr. Walker: Gentlemen I feel that I ought to thank you for this additional honor. I assure you that I am not unconscious of

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the honor of being president of this association for the year and presiding at this meeting. I disclaim, however, any of the honor of making this meeting a success. If it is a success through the efforts of any of its officers the credit should go entirely to the secretary. The secretary in this association is the whole thing; the president is a mere figurehead. While he nominally holds office for the year there are only three days' work for him and those are during the days when the convention is in session.

I thank you, gentlemen, again for this added honor, and I assure you that my presidency in this association will always be among my pleasantest recollections.

Secretary Moldenke: On behalf of the president I want to say that Mr. Walker made me the recipient of some very nice dinners in New York City when he came down to go over association matters, so he really did do considerable work during the year for our benefit.

Mr. Yagle: I would move that this association extend a vote of thanks to the Milwaukee foundrymen, and particularly to their entertainment committee, for their magnificent entertainment of the American Foundrymen's Association at this meeting.

Secretary Moldenke: I would like to add to that the City of Milwaukee.

The motion was seconded and unanimously carried.

Mr. L. C. Brown, of Springfield, Mass.: I would like to say that the ladies of the association have undoubtedly taken the same vote, so I don't care to have this association vote it; but I should judge from the interviews that I had this morning that they had pleasure—all of them no doubt—and I guess they all made the motion, because they all came to me and said, "you tell them so and so," and I don't really know what I was to tell you, they were so very well pleased with their entertainment. I remember one of them said that this is the first convention where they had a real trained "Bair" meet them at the station; he was very efficient. And furthermore someone said—it was an eastern lady I think—that they had never known what fish were until they came here, and that the lake fish—the white fish, I believe they called them—were the most delicious of anything, and that in their reception the other

evening, held in the parlors, the "Salmon" was very nice around there.

Last evening there was considerable worry among some of the men whose wives were deliberately taken from this hotel by the "Sheriff" and we could not understand the reason. None of us could find out what the trouble was, and we now believe that that remark of the Mayor the other day about the police protection was misleading—that we really don't have protection, because the "Sheriff" took those ladies out and they all came back with a big bundle, and I think I am safe in saying that the ladies have been very highly entertained and I am thankful for it.

Mr. Best : I move that a vote of thanks be tendered to the gentlemen who have prepared papers and lectures.

The motion was seconded and carried.

Mr. Magee moved that a vote of thanks be tendered to the Allis-Chalmers Co. for the courtesies that we will undoubtedly receive there this afternoon.

The motion was seconded and carried.

Mr. Sheriffs : In behalf of the Milwaukee foundrymen I wish to thank you all for your kind courtesy in selecting Milwaukee, and thank you all for your attendance, and if our efforts have been enjoyed we feel pleased. In behalf of Dr. Moldenke I want to compliment him on the fact of having the programme in the hands of the entertainment committee in advance. I also think it would be well in the future if the secretary could find out approximately how many people intend to come to a convention and arrangements can be made for them.

President Brown : Has any one anything to offer for the good of the association before adjournment? If not a motion to adjourn will be in order.

On motion the convention adjourned sine die.

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DISCUSSION ON MR. DICKSON'S PAPER ON "LOSS OF SULPHUR IN BORINGS OF CAST IRON.

Mr. West : I would like to say a few words on that point. My attention was first called to this loss of sulphur by Mr. Diller, and it is really the cause of bringing out this paper from Mr. Dickson. I would like to hear from Mr. Diller.

Mr. Diller : We had the foundry association drillings and they checked up with our steel, and we gradually found they got lower and lower after two years. They got to be .052 where they used to be .059.

Mr. West suggested that the paper be spread as much as possible; that he had no doubt that there was a sulphur loss.

Dr. Moldenke suggested that the Carnegie Steel Co., or the Illinois Steel Company might be asked to cast an ingot to be turned over to the standardizing bureau, so that a sample could be prepared; "If we could only get somebody to furnish the material we can take care of the rest. It would be a great benefit to the iron industry of the whole world. Our association now has the reputation and if we could get a steel sample it will be accepted equally well."

Chairman Flintermann : It might be well where there is a loss to find out just where that loss is.

Mr. West : I would say that the chemist who presented this paper was located right adjoining our office. He claims to have noticed that where the sample is in constant use—open more or less—that the loss is much greater than in one that is sealed.

Chairman Flintermann : I think the making of the steel standards would be a new field which would be of great help, because in most cases where you wish standardizing or checking of your method it can be done so much more quickly with the steel standard than the other. I think it would be an ideal arrangement to have both steel standards and the iron standards for all the constituents that we wish to check up.

Dr. Moldenke : Would it not be wise. then, to have a resolution introduced here that it is advisable to have steel standards prepared and undertake to get a vote upon that. Possibly we can

get one of the steel companies to give us these ingots. I make a motion, then, that the proper steel standards be prepared.

Chairman Flintermann : You have heard the motion that we take steps to provide acceptable steel standards.

The motion was seconded and carried.

Chairman Flintermann : I note that Mr. Mac Pherran handles a great deal of steel. Our company also does. It might be possible for us to secure these steel standards, or at least find out how they could be secured.

DISCUSSION ON MR. STUPAKOFF'S PAPER ON "THE MOLDING MACHINE."

Answering an inquiry Mr. Stupakoff said he favored the use of carriers in all cases where it was practicable.

Mr. Brown made the inquiry if the members had had any experience in the use of Pridmore machines. He said he had put them into the hands of his molders, who were Union men, and after they had used them for a while would say that they were unsatisfactory. He said he employed ordinary laborers to run the machines and got very good results; but he had found a great deal of difficulty in inducing his regular molders to use the Pridmore machines.

Mr. Gilmour said that he had found it almost impossible to get success with these machines in the hands of Union men; that he had had more success with them in the hands of laborers.

Mr. Ramp : This Molding Machine question is unquestionably the most difficult question the foundry foreman has had to give his attention to, if he has had anything to do with it at all. The gentleman told his experience and the trouble he had getting his molding machine started. It is the common story the country over, and the results that have been obtained from molding machines have been less in every instance of which I have ever heard when operated by molders than when operated by laborers. I know of a man at present who has about forty molding machines operated by laborers or machine operators; many of them cannot talk English. In the same shop there are ten to twelve machines operated by

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molders. The monthly report shows that in addition to his laborers producing the castings for forty per cent. less than the molders, that the loss on the machines by the laborers was about four to five per cent. and the loss on the machines by the molders was from eight to ten per cent. These are facts. I think it has been the history of every man that attempted to start a molding machine in a shop where there were molders that he has met that antagonism that has been spoken of here. The molder regards the machine as an encroachment upon his rights.

I have listened to these two papers which were read here today with a great deal of pleasure and profit. I have always been regarded as a molding machine crank, myself. But I do not feel that we go quite far enough with molding machines. I do not believe that we put enough stress upon the power molding machines, upon the conveying and elevating of our sand. I have seen where machines have been a success in one foundry, but they have not been a success in another foundry. It depends a good deal on the men that handle them. It is no criterion to go by—to judge a machine—to say, because you don't get the results always that the machine is an absolute failure.

DISCUSSION ON MR. GOBEILLE'S PAPER ON THE ORGANIZATION, MAINTENANCE AND MANAGEMENT OF A MODERN PATTERN SHOP.

A member inquired of Mr. Gobeille why he suggested heating his shop with hot water instead of hot air.

Mr. Gobeille stated that he found the hot water method preferable to the hot air system as it insured cleanliness; that hot air always contains more or less dust; that every effort was made to keep draughts of air out of the shop; to prevent dust coming into the room. He said that they required their workmen to wash their hands frequently; that they furnished plenty of soap and towels for this purpose.

Mr. Best: Mr. Chairman, the pattern shop I am associated with has hot water heating and we find it very comfortable and pleasant, because it is not a dry heat.

With reference to the machine—referring to the model exhibit by Mr. Gobeille—I believe that is a first class machine, but I would not like to see the trimmer done away with in the pattern shop. I think more accurate work can be done with the trimmer than through this machine. We have used trimmers for a number of years to great advantage. I don't say that this instrument will not do as much or more work; I am not acquainted with it, but it seems to me that the trimmer is a first-class machine in a shop. I am a pattern maker, and I ran a business of my own for thirteen years. I had a good deal of trouble to contend with in making pattern makers. I find that if the pattern makers, molders and machinists could all get together as outlined in the paper read by our president this morning, the better it will be for the molder and all mechanics. Some pattern makers insist upon square corners. It is not absolutely necessary that the pattern should be made square in order to turn out good work. I contend that a pattern with corners properly rounded will turn out a better casting than if made perfectly square. If pattern makers will get together we will come nearer to perfection. Pattern makers must be taken as much into consideration as molders.

Mr. Siviter : Mr. Chairman, there is one subject that concerns our foremen today, and it is this: Does the pattern maker give the question of cost in the foundry any consideration in making a pattern? My experience has been in many foundries that the question of cost of producing a casting does not commence in the pattern shop, where it should, but is left for the foundry only. Very little consideration is given in many of the pattern shops to the matter of reducing the cost in the foundry.

Mr. Estep : My experience is that foundrymen as a rule do not understand that we are unable to know from the drawing how they should mould, and the pattern maker has to determine that himself as a rule.

Mr. Frazer : I have found it a profitable thing to consult with the foundry foreman and follow out his ideas as far as possible consistent with getting out good work.

Mr. Gobeille : Mr. Best is perfectly right about square corners.

Mr. Spence asked the question, "In making large core boxes,

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say three or four feet long, by two feet wide and two feet deep, how much smaller would you make your core box than the print?"

Mr. Gobeille: Our practice is to make it very much smaller, say a half inch.

A Member: We have about five or six pattern makers in our business, and we have made them all ourselves. We take young men and put them into the foundry. We have an establishment where one can step right out of the pattern shop into the foundry. We also have another pattern shop that is situated on the other side of the river, a distance of probably several hundred yards, where we do all our main work. We put these young men in the foundry and work them about six months, and we also employ them off and on shellacing up patterns, and then we put them into this pattern shop adjacent to the foundry and we work them there until they have a service in connection with the foundry and pattern shop for about eighteen months, so that they are fairly good molders and know just exactly what is required. After the expiration of 18 months, we put them into our regular shop as pattern makers; and when a young man passes from the trial pattern shop to the regular pattern shop we put another young man in the place made vacant.

Our practice is to have the draftsman make pencil sketches of the machine, then we call in the foundry foreman and a superintendent of the machine shop and discuss the drawing with reference to the best results to be obtained in the foundry and in the machine shop, and that matter is decided. The drawing is finished and goes to the pattern shop, and when it comes to the foundry the patterns are generally correct. The castings are also as near as they can be gotten the size required by the machine shop.

DISCUSSION ON MR. KEEP'S PAPER ON RETORT OVEN COKE FOR FOUNDRY PURPOSES.

Mr. Blauvelt, who read Mr. Keep's paper, stated that he regretted Mr. Keep's absence very much, as he was better able to answer questions on the subject.

Mr. Flagg: What is the advantage, commercially or financially in the use of this coke—is there any?

Mr. Blauvelt: There may be. In order to find a market for retort oven coke, where there is a strong competition with other cokes, on account of its appearance, the price has, generally to be cut a little. Another advantage to the user, I think, as Mr. Keep pointed out, is that the source of supply is generally in the town near by, and near where the foundry is located.

Answering an inquiry Mr. Blauvelt said he thought the retort oven coke would absorb moisture more readily than Connellsville coke.

Mr. Spence: Will this coke stand the same pressure of blast that other coke will?

Mr. Blauvelt: I don't know, because I have not had anything to do with it in the foundry. I know they make as much iron with it.

Mr. West: The sample of retort oven coke shown seems to be better than the average Connellsville coke. We carried on experiments for several months with coke we procured from the ovens at Sharon, and our experience there in using that coke was that we had to use a milder blast.

Mr. Blauvelt: The Sharon ovens shipped to us. We rejected 50 per cent. as unfit for foundry trade.

In making foundry coke it is always carefully selected and the defective coke thrown out.

Mr. West: We found we could use that coke by a mild blast and careful charging—charging close; but if you left an opening in your charges, the blast would carry the fire right up and you would have fire at the top of the charging door.

Mr. Spence: How many ounces would you keep your pressure?

Mr. West: We would keep our pressure down to probably four or five ounces.

[Note on Mr. Longmuir's paper on the "Microstructure of Cast Iron." Part I.]

Page 99. In the legend of Fig. 5, the sulphur given should be 0.041 instead of 0.41 as stated; this being a typical white iron used as a base for the production of malleable cast iron.

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For biographical sketch of Mr. West see page 299.

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Managing Editor, DR. RICHARD MOLDENKE, P. O. Box 432, New York City.

ASSOCIATE EDITORS:

THOMAS D. WEST, Sharpsville, Penna.

HERBERT E. FIELD, P. O. Box 104, Ansonia, Conn.

S. H. STUPAKOFF, 545 Turret St., Pittsburg, Pa.

JAS. A. MURPHY, 114 W. 20th St., Erie, Penna.

WM. H. PARRY, 551 Pacific St., Brooklyn, N.Y.

KENNETH FALCONER, 34 Staynor Av., Westmount. Montreal, P.Q.

EDITORIAL COMMENT.

OUR JOURNAL.

In deference to the wishes of our members as expressed at the Milwaukee Convention, the committee appointed for the purpose of devising ways and means to increase the usefulness of the Journal of our Association, may herewith be said to make a report.

We are fortunate in securing the services of the able men who head their respective departments, and trust that our members and friends will keep them so occupied with answering questions and studying phenomena along foundry lines, that they will realize the truth of the saying in America, that a man "is only kept up to his mettle by the strenuous life." While this happens to be the case with all our editorial staff, and those of us who did not pen the above are no doubt wondering how they can cram more work into their daily pensum, yet we all know that to get anything done, we must turn to the busy man. Let our members therefore show their interest in the work by furnishing the nuts to crack. This can only bring material of value to the surface, which will benefit us all.

We bespeak the good will of the Foundrymen of America, and trust that they will second the endeavor of the American Foundrymen's Association to elevate the standard and standing of the foundry industry by educational work such as that we are now engaged in.

The JOURNAL, which is indeed a compendium of modern

foundry thought, is to the Association and its active members a labor of love, and truly deserves the encouragement and substantial help of the industry it represents.

SECTIONS FOR PATTERN FOREMEN AND FOR FOUNDRY ACCOUNTANTS.

The attention of our readers is directed to the appeals made by our Associate Editors anent the formation of two new sections in the Association. The phenomenal success of those already established for the Foundry Foremen, and for the Foundry Metallurgists, together with a general expression of opinion at our recent convention justify us in the belief that it will take but little effort to organize a special section for our Foundry Pattern-makers, and another for our Foundry Accountants.

The various branches of the foundry are becoming so very much specialized that the careful study of each must necessarily fall to men exceptionally well fitted along the lines in question. Again the progressive man will always look for whatever is going on in his line. He expects to gain, and does gain from all associated effort, and where, as in our Association, the educational side of every question is made a paramount object of its work, surely every foundryman will act for his own interest in encouraging his foremen and clerks to join the several sections they can learn most from.

We hope to have these two sections in a flourishing condition before another year has passed. We have able men working for that object disinterestedly, and only for the good of their callings and the foundry industry at large. And it should not end there, for let a foundryman count on his fingers the number of departments he has, the foremen of which can stand some exchange of ideas occasionally, and he will soon see that a dozen sections would be better than four. In many an extensive foundry and manufacturing plant, the departments are considerably over twenty.

We again, therefore, bespeak the kindly attention of our members and friends in behalf of these projected sections, and will be only too glad to be of assistance in furthering this object to those who will communicate with us.

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INSTRUCTION PAPERS.

As will be remembered by those who attended the Milwaukee Convention, it was decided to issue Instruction Papers, of an elementary character under the auspices of our Association, the object of which was to gradually cover the entire foundry field. These papers were to be not only printed in the JOURNAL, but should be made available for distribution to all applying for them at practically cost price. Again, the character of these papers was to be more elementary than those of the Correspondence Schools; if anything, they should serve as a preparation to these admirable institutions. Thus an apprentice who by means of our papers becomes sufficiently interested to want to know more, will find his thirst for knowledge well satisfied by taking a course in one of these schools. He will, if at all apt and skilled, surely make himself more valuable to his employer, and greatly better himself financially and otherwise.

We would therefore urge employers to send for enough of these papers, which will be issued in pamphlet form,, to hand a copy to each man in their employ. A certain per cent. will naturally overlook the matter contained, but the few men who give the papers earnest study will be the ones to amply repay the outlay. The price of each paper will be 10 cents for single copies, or $2.00 per hundred. It is confidently expected that among our membership, and outside of it, many will avail themselves of this opportunity to help solve the labor problem by means of individual education, instead of the usual way of strikes and lockouts.

Two papers are given in the issue of the JOURNAL, by experts of the first rank. One by Mr. West, on the subject of molding, and another by Mr. Field, on foundry chemistry. They will be continued in the succeeding issues of the JOURNAL. Later on we hope to have pattern-making, core-making, and other kindred branches of our industry represented, as well as much general matter which bears upon the foundry, taken up in due course. We need co-operation from our members and friends, and feel confident that we will get it.

CONTINUOUS FOUNDRY PROCESSES.

The problem of running the foundry continuously is being taken up with more and more vigor, every now and then some appli-

cation or other being mentioned as successful and highly profitable. Naturally the specialty foundries take the lead and numerous are the examples that may be cited where some portion of the daily routine is made continuous for a week.

It is with especial pleasure therefore that we illustrate the new works of The Thos. D. West Foundry Co. We are indebted to the *Iron Trade Review* for the subject matter which will be found on another page, and suggest to our members that they look about their works and see if there is not some branch which could with proper management turn out double the interest on the investment in the same number of months. It will pay them to so look about.

We wish The Thos. D. West Foundry Co. all possible success in their undertaking, as a practical demonstration of this kind can only stimulate the industry to a further step in the right direction, and the whole country will be the gainer thereby.

OUR MERCHANT MARINE.

The above title looks rather out of place in a foundrymen's Journal, but it has a far deeper significance to us than would appear at first glance. The re-establishment of the American Merchant Marine to its former rank in the carrying trade of the world is not only a patriotic duty, but a sound business method on the part of the Nation. Our Western members are probably only affected in its general prosperity, and the safety of the national transportation facilities, but Eastern foundrymen should take the livliest interest in everything that affects the foreign trade they are bound to cultivate sooner or later.

Mr. Aaron Vanderbilt is the chairman of the committee on the Merchant Marine of the New York Board of Trade and Transportation, which is actively engaged in stirring up this important matter. It is to be sincerely hoped that they will succeed in creating so strong a sentiment that our Merchant Marine will be speedily rehabilitated.

STEEL FROM MALLEABLE CAST IRON.

Every once in so often we hear of a new discovery along the lines of making steel from cast iron. Less frequently it is given

out a little more frankly as being steel from "malleable." The other day an excitement of this kind struck a large city in western New York, everybody "who's who" taking some stock; The history of this venture will be recorded exactly as was the one last year in New Jersey, the year before in Eastern Pennsylvania, before that in Ohio, and so on back some thirty-five years. The patent office teems with mixtures intended to work this seemingly desirable conversion, and the secret processes cannot be counted.

Now, as a matter of fact, malleable castings have been sold for steel for more than fifty years, and evidently without any special fear of detection, the material being in the shape of edged tools for wood-working. Indeed some of the best milling cutters intended for wood-working machinery in existence are simple malleable castings which have been machined, hardened and tempered.

The secret lies in the fact that a piece of malleable consists of three grades of material, which blend into each other but nevertheless possess definite properties of commercial value. The skin of the casting is in reality a low carbon steel, but much oxidised, it cannot be hardened, hence it is very properly removed by machining the article about ⅛". The second grade of metal, just below this skin, is a steel varying from the mild variety to the highest carbon steel, all within ¼" thickness. It is this portion of the casting which is hardened and tempered with success. The third or interior part, which, in the tools under discussion, is oftenmissing, but is the center of thick castings, is a high carbon iron similar to the cast variety, but has its carbon in a very different form. It is the "temper carbon" we read so much about and which can be redissolved by the iron by heating to red heat and quenching. The material after this treatment is, however, of indifferent quality.

If therefore an article is cast of good metal, is well annealed, then machined to remove the skin, is then hardened and has the temper properly drawn, it will exhibit all the characteristics of steel, usually gets "cast steel" stamped on it, and will render excellent service on soft materials, such as wood, leather, etc.

Whether the customer cares to pay steel prices for treated "malleable," and uses the tools as this material requires it, is another story. He will, however, undoubtedly continue to do so until much more general knowledge on this important matter has been let go outside the factory doors.

In the meantime, it would be well to fight shy of secret pro-

cesses as a means of investment, and when an inventor comes along and brings you a treated hatchet with the edge turned over, (for this is what the genus experiments with, in spite of the fact that close grained cast iron, well annealed, does the same thing) ask him to call again at your office in the moon.

TECHNICAL EDUCATION ABROAD.

According to the special report of one of our consuls in Germany, that government is adding two technical schools to the nine already in existence. In addition to this the government supports selected private institutions of a technical character. This will show the interest taken in Germany's fountain source of industrial greatness. The direct consequence of the fostering care thus bestowed by the people is seen in the remarkable growth in at least one industry, that of the chemical, which today surpasses that of all other nations, its products being more than $238,000,000 annually.

The spirit with which this industrial educational movement is taken up in Germany may be noted from the fact that some establishments have no less than a hundred chemists in their laboratories, their sole work besides taking care of the running of some department being the experimenting along lines to extend it. Imagine a few of our large foundries placing a dozen metallurgists in similar lines of work, each one to solve a special evil we are all laboring under. Under present tendencies we would think that the millenium were at hand.

Pittsburg can congratulate itself upon the fact that it will soon have an institution second to none where her sons and all others may receive a technical education suited to their necessities. It cannot come too soon for the Country, and our foundry industry especially is waiting for a speedy opening of its doors.

As a sharp contrast to the liberal ideas of the German government in matters of educational moment, we hear of the often revived movement to cut off the advantages of the German university and technical school from all foreigners (meaning thereby Russians and Americans principally). These foreigners are said to learn too much of Germany's industrial life for her own good. If true, it would be enough to make the proverbial horse laugh, for anyone who may have been handed as many letters of introduction as the writer from German friends commending the bearer to American

courtesy and at the same time soliciting the privilege of studying our methods of work, can appreciate looking over the long procession of German manufacturers, statesmen, capitalists, professors, and students, who for the last 20 years have overrun the works of this country, many of them with note book and pocket rule, copying, begging information, wherever it could be had, and even on occasions buying it. Truly the shoe would seem to be on the other foot, and little is the wonder that our hospitality is lauded everywhere and at the same time taken advantage of.

Germany need therefore have little fear of giving our inexperienced students what it does, and indeed all thinking men know that this small potato movement now being exploited on the other side does not have the serious consideration of the high minded nation we like to meet in commercial battle on the world's fighting grounds.

MOLDING.

Edited by THOMAS D. WEST, Sharpsville, Penna.

Discussions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. West.
The Instruction Papers of this department are sold at the uniform price of ten cents a copy. Founders and others desiring them in quantity can get them at $2.00 per hundred. Send remittances to American Foundrymen's Association, P. O. Box 432, New York City for prompt shipment.

INSTRUCTION IN MOLDING AND CUPOLA WORK.

By THOS. D. WEST.

PART I.

Introduction. The Branches of Iron Founding.

The art of molding iron castings is divided into three branches. Molding in Green Sand, Dry Sand, and in Loam. The first division requires sand of such a nature that it will hold the form of the patterns in the flask, and allow the molds to be poured while the sand is in the damp state. The second division is similar to the first, except that the sand is of a more loamy nature, and the molds are dried in ovens or by other methods, before they are poured. The flasks in this case must naturally be of iron, while for the first named division, in America, the flasks are usually made of wood.

The third division differs radically from the other two. Here the mold is formed of bricks and iron plates, the face having a coating of loamy sand, to the thickness of ½" to ¾", put on in a plastic state. The molds are dried as with the dry sand method. To give these molds stability, so that they may withstand the head of metal while pouring, they are rammed in pits, or, if on the floor, in iron casings.

Risks attending the making of castings.

It is not easy to get perfect castings. There are always more or less risks attending this work. The Molder who never lost a cast does not exist. The best record known is that of Mr. Micheal Lally, of Cleveland, Ohio, who for ten years, six of which were spent under the writer, on the most intricate classes of engine and machinery work, made perfect castings ranging from one ton up to twenty, and never lost a single one.

The risks taken will depend upon, first, the experience and skill of the molder, and the management. Second, upon the shop

appliances, and third, upon what we may call luck. The more brains and skill put into the work, and the better the appliances, the greater the luck. The risk of losing castings is as a rule greater with green sand work than with dry sand or loam. This is because the dampness present in green sand molds creates steam when the hot, seething metal rushes in. Also from the difficulty in holding of sand rigid under these circumstances. It is therefore a somewhat delicate matter to mix up green sand properly. If too dry it will not hold up well in the rigid form necessary to keep the pattern shape. If too damp the excessive steam generated can cause "scabs," blowing, and even explosions.

If the uninitiated will look at a large green sand casting, on the one side, and a sand heap, a pattern, cupola, and pig pile on the other side, a little serious thinking will convince him that there is more to making a casting than digging a hole, and pouring iron around it, as some one has aptly put it. One can ram a dry sand mold as hard as a stone, and not vent it at all, but if thoroughly dry it can be poured successfully without the least sign of bubble or boil.something if attempted with a green sand mold would send the metal skyward, and leave what would be left of the casting in a far different shape from the pattern.

Desirability of Understanding the Principles of the Art of Founding.

Molders with experience and skill can much more successfully turn out good castings with poor appliances,than others,not so well versed, can do with the best. It is the understanding of principles which brings this about. Too many molders are mere imitators and can only learn by sad and costly experience. Work to which they have been drilled by the experience of others, may find them fairly successful, but let them take up something they have never seen done, and there is no end of excuses for bad work. There are occasions when excuses are justifiable, and current practice has it that "he is a poor molder who cannot make a good excuse," nevertheless those who are best versed in the principles of the art will have the least occasion for excuses.

The Adoption of Good Appliances and Their Value.

The day when anything was good enough for the foundry has passed, and much of the excellence of light and heavy castings as made today is due to the improvements in appliances for the foundry made in the last twenty years. No modern foundry would think of making light and heavy castings in the same grade of sand,

Light castings require fine sand, while for medium and heavy work, coarser grades are adopted. Every effort should be made to obtain the sand most suited to the work in hand. No expense should be spared to have the best patterns and flasks. Any appliance to save labor (if allowed) should be adopted. Shops should be well lighted and ventilated. All these things tend toward a reduction in the risks attending the making of castings.

Pardonable ill-success.

A molder should not only learn to turn out work of quality, but in quantity. The greater the experience, the more proficient should the molder become in regard to the points which can be slighted without impairing the excellence of the work. Attempts to slight work, in order to acquire speed often means taking serious chances with the castings. To be absolutely certain of success often means the expenditure of more time and labor than the molder is justified in giving to the work, and hence many a molder takes this chance. If he is possessed of good judgment he will know enough not to overstep the danger line. Approaching this danger line invites ill-success, and this, while rarely excusable, is less so where the molder knew how to act intelligently. Only when occurrences are beyond our control, is a mistake pardonable. If a molder is compelled to make light castings in coarse sand, he should not be held responsible for their rough surface. If he gates his castings as usual to run well, but must use iron so dull that it will not run full, he should not be blamed for it. While these items illustrate the sins that are pardonable in the foundry, there are many others that are not so readily excusable, and the foregoing will illustrate the contention that a careful study of the principles underlying the art of molding will enable one to distinguish between the error due to ignorance from that due to carelessness or bad judgment. Hence the series of articles of which this is the introduction will not only be useful to the apprentice, for whom it is intended, but to experienced molders as well. It is to be hoped that these instruction papers will assist in building up the Association to the desired point it should have attained long ago.

GAGGERS.

The Foundry, May. Mr. Jas. A. Murphy discusses this much mooted question, giving the reason why a plentiful supply of these

important molding adjuncts should always be on hand in the foundry. In many foundries, more time is spent by molders hunting up gaggers, than would be required to complete the job they are in. Molds are frequently lost through the use of wooden soldiers which mean scabs and other troubles. Forced by circumstances, Mr. Murphy devised a chill mold, water cooled, into which the iron is poured for the gaggers, the whole form working on trunnions to dump them out, the warm water flowing out of the mold being utilized by the molders. The gaggers on each side of the chill are gated in such a way that when the plate is turned over the gated side is always next the pourer. The gaggers do not crack at the heel as might be expected, a small nick at the joint of the gate and gagger allowing them to separate easily. This method makes gaggers at but little cost, and the iron can always be remelted. Wrought iron gaggers are quite expensive in the long run, on account of the time necessarily spent to keep them straight. By the time they get out of the core room, they are scrap. Mr. Murphy then describes a special gagger for deep lifts which looks like a very open grid-iron with a flat heel of equal width, a device which saves much re-barring otherwise necessary when wooden soldiers are employed or where hanging wrought iron gaggers are the rule.

CHILLING CAST IRON.

The Iron and Machinery World, in its anniversary number, gives Mr. Edward Gilmour's article on cast iron. He describes the chemical side of the phenomenon, and then gives practical points on the process itself. The chills which produce the results aimed at, when the iron is of the proper composition, are made of gray iron, chilled, polished, and coated before use with wet plumbago blackening. Then they are dried and heated up to 250° F. It is best to pour from the bottom, if possible, and so direct the stream that the chill is not cut by the flowing metal. Pouring from the top causes splashes, and as a consequence, dirty iron. Mr. Gilmour claims that it is best to have the chill as light as possible, so as to radiate the heat quickly, and that the thinner it is the deeper the chill of the casting. While this may be satisfactory for light work, it is at variance with heavy roll work, where the best results are produced by the heaviest chills, the lighter ones giving much trouble. To get good chilled castings the silicon must be kept below

one per cent., and the manganese should vary between .70 and 1.25 per cent.

MAKING MOLDING SAND.

American Machinist, May 28. the caption of this article will no doubt recall to most of us our more or less ancient experiments to make a reliable molding sand out of the material we happen to have in the neighborhood, adding thereto suitable quantities of fire clay. Now while we were doubtless well satisfied with the results, strange to say, we are all placing our orders with nature's laboratory, which can supply the quantities and grades wanted without any special machinery. The article of Mr. J. C. Green, of Hackettstown, N. J., is therefore of special interest in this connection, he also putting clay as a bonding material into ordinary sand. The final method adopted by him was to mix up a barrel full of blue clay with water, and to wet down the sand with it. Gradually the material became first class for foundry work, and excellent results came out even with careless molders. The practice of wetting down the sand with clay wash this way is novel, and it should be a pointer to many a foundryman whose facilities for bringing on molding sand are not too good.

BLOW HOLES.

The Foundry, July. In the first place we must find out what blow holes really are. Porousness in a casting is not related to the blow hole, for proper feeding will remedy this. Poor design will produce shrinkage spots, sinks, or hollows, as they are called. Thickening the light sections and feeding well is the solution here. The sand hole, or dirt hole, which is the blow hole, requires careful treatment by the molder in the first place. Good venting, hot metal, the sand at gates and runners properly swabbed, the basins kept full while pouring, a core set where the metal drops deep; these things help to prevent blow holes. The metal should always be calm before pouring, the molds should let the steam pass off freely, and good venting also lets the air out so that the metal rises quickly into the mold. Where it is impossible to avoid the lodging of dirt into upward projections, arrangements should be made to force it into some unimportant part of the casting, where it does no harm.

CLEANING CASTINGS.

Engineering Magazine, May. The dressing up of castings is discussed by Mr. Robt. Buchanan, in the continuation of his series of papers on the modern foundry. Rattlers are taken up first, there being little difference observed between the round and octagonal forms. Care should be taken to have bolt heads flush on the inside and that no shaft may run through the barrel. The dust is best drawn off by a fan. Castings to be tumbled must be neither too delicate or too heavy, otherwise trouble results. Stars, sprues, or as our English friends call them "gits", are best used to do the cleaning. Mr. Outerbridge's discovery of the increase in strength due to tumbling is next noted, and favorably commented on. As a result of this discovery, Mr. Buchanan suggests that two speeds be given the tumbling barrels, a slow one for the first part of the cleaning, and a fast one toward the end. The sand blast is described next, then pickling with either sulphuric or hydrofluoric acids. Carborundum and emery wheels are next ventilated, and an interesting application of the flexible shaft for grinding purposes illustrated, being intended to act upon heavy castings in place. Pneumatic chipping tools for taking off iron fins can often be used for much heavier work, and finally when the castings have been gone over by the inspector, with the aid of the molder's private marks, they are sent to the chipping and assembling rooms.

ODDSIDES.

American Machinist, June 11, 18. In his admirable articles on brass founding, Mr. Chas. Vickers, among other things, explains the best methods of making matches, or "oddsides." A good match is a recognized money-maker, and need not be specially defined here, as all our foundrymen know what it is. While Mr. Vickers treats more specially of the brass foundry, his points are equally applicable to the gray iron shop, and hence we quote copiously, as follows:

"In many instances it is neither necessary nor desirable to make a permanent match, as one of sand will amply fulfil the requirements. Such is the case with a "side" of loose jobbing work; although when the side is made up it may run for days without change. We will therefore first consider the making of green sand

oddsides. In this instance we will suppose we have a number of small loose patterns from which brass castings are to be made. The first thing is to ram up a blank oddside, and, for the better convenience of "bedding in" the patterns, it should be made no harder than an ordinary mold.

After the surface of this "side" has been leveled and smoothed with a trowel, it is dusted with parting. Well burnt sand, pulverized rosin, or rosin and charcoal are used for this purpose. The patterns are loosely laid on the match, and it is decided whether one or more runners are necessary. The runners are then laid in their places and the patterns are arranged in the positions in which they are to be cast, after which they are each lightly rapped down to leave an impression of their shape on the soft sand, which impression is roughly dug out, (keeping within its lines) with a gate cutter or a brass tube, and the patterns are finally rapped down to their parting lines. The nowel of a flask is now placed in position on this "match," more parting is dusted on, and the flask is rammed up. The whole is then rolled over, and the temporary oddside is lifted off and thrown out, having served its purpose.

We now have a half mold with each pattern bedded therein according to the manner in which it must be parted, but it requires trimming, and sand will often need to be added in one place and some cut away in another; and whenever there is any doubt as to the parting of a pattern, after the same has been trimmed according to memory, the pattern should be swabbed with water, rapped and withdrawn a little way so that any hidden projections may disclose themselves, when the parting can be altered accordingly. When each pattern has been trimmed and the general surface of the mold leveled as well as possible, the oddside frame is adjusted, and once more liberally dusted over the mold. The frame is now rammed with ordinary sand. A good way to do this is to tread it, as the danger of striking a pattern is thus avoided. The oddside we are considering is made in a frame and so has no pins or other guides to assist in lifting off; consequently it must be rolled off, which is accomplished by bearing down with one hand on one side or end, and lifting with the other hand at the opposite end, with an action like raising a hinged cover. To insure a clean lift, it is advisable to "take a rap," that is to have some one strike against the sides of the molding tube or bench, lightly and on alternate sides with the closed hands. When the match is rolled off it may be placed at

one side, out of the way, while the mold in hand is finished. After that is done attention can be again directed to the oddside or match, which will often require considerable trimming, as all partings are generally full, and must be cut back, and then the match may be well and carefully wetted, and afterwards dusted with parting, the patterns and gates can be placed in their positions, and the "side" is again ready for molding from. It is quite a trick to make a good sand oddside and more of a trick to keep it good.

The oddside we have just made is good in its present soft condition for three or four molds; then it rapidly deteriorates, becoming hollow in some places and lumpy in others, so that it has to be straightened.

This straightening process is simple, provided the surface of the oddside is level with the joint of the frame or flask in which it is rammed up. For instance, a number of spheres or a set of valves or plugs, would have such a match; as the patterns would be merely sunk into the sand. To straighten this match, it is once more wetted, and extra well dusted with parting; then a smooth board or plate is laid onto its surface and the match is rolled over, the bottom board is removed, and the frame smartly rapped down to a solid bearing on the plate. Then the sand is rammed over with the butt rammers, using firm but very slight strokes and not missing a spot, after which the bottom board is rebedded, and the match is rolled back again. The plate being removed, the patterns are put back and rapped home, and the match is good for a hundred flasks or more.

In the case of a match with a crooked surface it is obvious that the foregoing method cannot be used; but where there are any flat places that are full, these may be straightened while the match is soft by placing thereon a flat surface, such, for instance, as a trowel, and if this is rapped down until level with the frame, and shifted from one spot to another, the flat places can all be leveled. Where the oilly portions are too full they can be cut away again, but if depressed, building up must be resorted to after scraping away the parting material and wetting. when the surface of such an oddside is sunken after a few molds have been rammed on it, and the building up process is too tedious or not practicable, such places may be raised by placing sand on the bottom board under the spots.

When an oddside has been once straightened it will usually last for a long time without other attention than spraying with wat-

er occasionally to keep it fresh, for such oddsides must not be allowed to become dry or they will crumble. In the evening after the day's work is done, the oddsides should be well wetted and a wet cloth spread over them. Treated thus a sand oddside will last a long time and give good results.

The efficiency of the match above discussed depends upon its being kept green. If allowed to dry it not only crumbles but, by absorbing the moisture from the sand of the mold that is rammed upon it, makes it impossible to obtain a good joint. Consequently for oddsides that must be laid aside for a time and taken up again under conditions that make it difficult to keep them damp the dry-sand oddside is often used, and is made as follows:

Take new sand and add flour in the proportion of one to ten of sand, mix well and sift, then wet down and ram up as described for green sand match. It is not necessary to dry it by artificial means, but no pains need be taken to keep it green, and naturally it dries in time and becomes hard, and will last a long time. In fact, such a match has been known to last for years. It has its limitations, however, and is effective only on certain kinds of work. On globular, cylindrical and other similarly shaped patterns, which are sunk below the match surface, it is worthless when dry, as the edges of the sand surrounding the pattern chip off, making it necessary to tool around each pattern on the nowel before the cope can be proceeded with.

Before making a permanent, or hard, match for a strange job, with a difficult parting, it is a matter of prudence to run off a heat or two from a green-sand match so that the molder may familiarize himself with the patterns. This is especially needed with small gated work, for, although the parting lines may apparently be well defined and the match made accordingly, actual molding may suggest changes that will considerably affect the output.

One advantage that a sand match possesses is that it is ready for use as soon as made, and so also are the patterns as there is no oil to be cleaned off.

A match that combines the good points of the sand match with the lasting qualities of the hard match is known as an oil veneer, and is made as follows: Dry, new sand is sifted and mixed with about one fourth its bulk of plaster of Paris. Water is added until the mixture is as damp as ordinary heap sand. It should be used immediately, as it soon hardens and becomes useless. Before the

sand is wetted the patterns are arranged in a "side," the half mold is rammed up, rolled over, and the joint is made and well dusted with parting. A frame of the required size and an inch and a half in depth has nails driven inside, so that they will project into the sand and hold it in place; it is then placed over the pattern. The mixture of sand and plaster is wetted, as aforesaid, and then rammed into the frame, the same as for an ordinary mold. Instead, however, of lifting the match off the half mold it was made on, the whole is rolled, so that the oddside is underneath, and the mold is lifted from it, leaving the patterns (if of metal) on the match, which should be cleaned of all loose molding sand and the patterns swabbed around, well loosened and drawn. After they are removed the match may be well wetted, dusted with parting, and the pattern replaced, when it is ready to mold from. The pattern will require rapping on the first few molds uutil the match has ceased to shrink.

If the operation of molding from the match shows that the parting lines are not correct they may be built up or cut away where expedient, and by evening it will be in good working condition. When the last mold of the day has been made from it the match should be thoroughly varnished with linseed oil and left to harden until morning.

The best all round oddside, however, is the oil match. It is made with sand moistened with linseed oil instead of water, a small quantity of litharge being generally added to aid the hardening process. It is rammed up the same as the preceding example, but the patterns must be oiled. It should be made in the evening and allowed to harden during the night, and if more time can be given to it so much the better.

Plaster of paris also is extensively used for making oddsides, and in this case also the pattern must be oiled. The plaster is mixed by adding it to water, a little at a time, until the liquid is of the consistency of thick cream. A little is first run around the inside of the match frame as it lies on the half mold to seal the joint and prevent leakage. After this thickens the rest of the plaster may be poured in until the frame is heaping full, and when partially set the surplus plaster is struck off the top of the match with a straight edge.

It is not necessary to place a bottom board under a small plaster match unless it is less than 1½ inches thick; neither in casting

the same need it be banked all around with sand and heavily weighted, although a small weight may be placed thereon to prevent the frame from springing. The simple precaution of sealing the joint between the mold and the frame will be all that is necessary to prevent leakage.

Plaster of paris cannot be used as a match for all classes of work; on a scroll, for instance, where numerous little slots and odd shaped holes perforate the casting, with parting lines at the centers of the same, half of the core being lifted in the cope and half left in the nowel. It is very difficult to remove the pattern without breaking off some of the cores, and if a match for this kind of work is not perfect it is of very little use, as it will be necessary to tool each parting,

In many instances I have used a match made of a mixture of pitch, rosin and sand. The patterns must be of metal (as the mixture adheres firmly to wood) and well oiled with a heavy oil. The pitch is melted at a gentle heat, and rosin is added in the proportion of one-third. When the mass is liquid dry lake sand is stirred into it. the idea being to get in as much sand as possible and yet have the mass liquid enough to flow into the match frame. When this stage is reached it is cast, and as soon as set it must be rolled over and the patterns pried out and cleaned with kerosene.

This match has the advantage of being easily patched by means of a hot iron. It never breaks and lasts for years.

CHOOSING A FOUNDRY CUPOLA.

Cassier's Magazine, October, gives an article by Mr. Joseph Horner, on the above subject, which it also abstracts as follows:

"Though there are several good cupolas to choose from, there are none that will yield satisfactory results unless they are in charge of good melters. The work of melting metal, though done by so-called unskilled men, or men without a trade, is as much an art as molding itself, of steel or brass melting. An incompetent man will not tap out the same class of metal that a good hand will, but he will run something into the ladle that produces unsatisfactory castings. The failure to secure perfect melting is often due to ignorance, but more often it is the result of an endeavor to get a high

melting ratio, thus risking wasters in order to save coke. Or again it is due to the employment of inferior coke, low in heat units, or overcharged with sulphur. It is well to mention these things, because there is a too common impression that some cupolas possess occult, economical virtues which are bound to effect a great saving in the coke bill. As far as the cupola design is concerned, the essential points are good height, complete and even distribution and proper regulation of the blast in the melting zone.

"A common cupola of good height, with single or double rows of tuyeres, and blast regulated to suit the nature of the melting being done, will produce good results. Ireland's cupolas gave the best results a generation ago because they were tall, and height utilizes heat to the best advantage. Belts of tuyeres, and double rows of tuyeres are better than two or three tuyeres only, because they distribute the blast more equally. Double rows, capable of regulation, permit of melting light or heavy charges at will, and of more rapid melting than a single row, while a receiver is a useful addition to big casts, as tending to a better mixing of the metals. Increasing blast pressure results in more rapid melting; but pressure must also be varied to suit the coke; hard coke requiring more than a softer quality."

METALLURGY.

Edited by HERBERT E. FIELD, Box 104, Ansonia, Conn.

Discussions, comment and criticism are invited Kindly direct all correspondence for this department direct to Mr. Field.
The Instruction Papers of this department are sold at the uniform price of ten cents a copy. Founders and others desiring them in quantity can get them at $2.00 per hundred. Send remittances to American Foundrymen's Association, P. O. Box 432, New York City for prompt shipment.

CAST IRON.*

A Consideration of the Reactions which Make it Valuable.

My reason for bringing so general a consideration before a body whose chief attention is devoted to the study of testing, lies in the fact that if we are to successfully adopt tests for cast iron we must have a complete knowledge of its composition and reactions. It has been the lack of this knowledge that has led to repeated statements that cast iron was not a reliable product; that its composition was only an imperfect guide to its properties, etc.

Only in the midst of actual experience in melting and using all grades of cast iron under different conditions and for different kinds of work, do we begin to realize its complex nature and reactions. Under such conditions one is able, in endeavoring to explain the many problems and apparent conditions which arise, to get an inkling concerning the causes which underly these changes, and to explain many of them.

Cast iron has not, to my knowledge, been previously presented in the light in which it will now be considered.

The properties which make cast iron an invaluable product are its low shrinkage, and its fluidity, which combine to produce an exactness in outline of mold; together with its adaptability to various kinds of work from the softest casting to the hardest chilled product. We know that carbon, silicon, sulphur, phosphorus and manganese each has its part in producing the above properties. We are acquainted in a more or less accurate degree with the intensity of the actions of different percentages of these elements. This knowledge is, however, but superficial and is obtained by observing the effects of certain amounts of these elements on the resultant product. The reasons for these results and the reactions which take place during their accomplishment are what we are now

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concerned with, and for which we will try and offer an explanation. A consideration of the reactions which make cast iron valuable, will form the subject matter of my paper.

Cast iron is iron containing various impurities which give it the properties necessary for its application as a cast product. It is distinguished from cast steel by its carbon content. The line where cast steel leaves off and white iron begins is an indeterminate one and will become more and more so as we become better acquainted with this subject and put our knowledge into practical operation. We are wont to divide cast iron into two regular divisions—white and grey iron. In the former we have the malleable and chilled divisions; in the latter the innumerable different grades of grey iron each adaptable for a different kind of work. I have said that the per cent. of carbon was the distinguishing line between cast iron and cast steel. I further state that cast iron is cast iron because of its carbon. We must take into account the properties of this exceptional element if we would study cast iron and would understand the varied reactions which take place in its formation. The fact that carbon, of all the elements, will produce these effects upon iron gives us the clew to the various phenomena noted in our study. Let us for a moment consider these properties which make carbon the controlling element in cast iron. We have as yet been unable to melt carbon; the highest temperature of the electric furnace has failed to overcome the attraction between its particles and change it to a liquid. It is this property which makes carbon so prominent a factor in iron and steel. It will be further noted that the temperature at which iron is heated, and the forces exerted by the iron particles during these temperatures, is sufficient to overcome the attraction existing between the carbon particles and allow them to move freely about with the iron particles in the melted iron; or inasmuch as we are for the moment considering the properties of carbon, we can reverse this statement and say that the attraction between the particles in the carbon is just such as is overcome by the high temperature of iron, together with the action of the particles of iron at such temperatures. Tin, lead, antimony and copper have no such effect on carbon. Either their temperatures are too low, or the action of the particles insufficient to bring about the disruption of the carbon. The carbon molocule is considered to have a large number of atoms, and this fact has its application in its action in cast iron. The specific heat of carbon at high

temperature is .459, which is the highest of any known solid element, and this varies as the temperature rises. (The explanation of the bearing of this point will be made later in the paper.) We have then four properties which make carbon the controlling element in cast iron.

First: The great attraction between its particles.

Second: This attraction is overcome at just such temperatures and by just such action as is present in cast iron.

Third: The carbon molocule is composed of a large number of atoms.

Fourth: It has a high specific heat which increases as the temperature rises.

We are told that cast iron is a mixture of steel with fine graphite intermixed. If true, it is an interesting fact to know, but it is of little practical value to us in our use of cast iron. It is the reactions which take place in the formation of the product which will be of value, if we can but understand and control them. A ladle of steel, with graphite mixed in mechanically, would not be much like cast iron. It is the reactions which take place, and the manner in which they take place, when this graphite forms that make cast iron so useful a product. Its first value lies in the fact that it may be cast into moulds and retain the form of those moulds even though they be thin and intricate. It is valuable then because of its fluidity.

Take a ladle of steel in the molten state; it will set quickly; it will not run thin, intricate shapes; it shrinks badly. Let us now mix with it mechanically some graphite, stirring it in well with a rod. Will it remain hot any longer? Will it run a thin casting any better? Will it shrink any less? Not perceptibly. What is it then that makes our cast iron suitable for casting?

Pure iron when melted has none of the properties which would make it suitable for a cast product. Carbon and iron under certain conditions make what is known as cast iron. What are these conditions?

If we bring molten iron at a sufficiently high temperature in contact with incandescent carbon the iron will absorb the carbon or will enter into a solution with the carbon. Let me again refer to the strong attraction existing between the carbon particles. This attraction must be broken or weakened to allow this formation of solution by the carbon and iron. When two bodies enter into so-

lution heat is rendered latent. So in our iron-carbon solution, there must be heat given up to overcome the attraction existing between the carbon particles. The amount of heat so used up must be considerable, when we consider the great attraction existing between the carbon particles. This heat rendered latent in the solution of the carbon with the iron must be changed into motion of the particles of the carbon.

Pure iron under maximum conditions of temperature is said to absorb about 6½ per cent, of carbon. The latent heat used up in the solution or dissolution of this carbon, together with another element which will be considered later, forms the chief factor in reactions which cast iron undergoes in the casting process. Let us assume for the moment, iron heated to a sufficiently high temperature and holding 6 per cent. carbon in solution. This iron is allowed to cool slowly; as the temperature decreases some of the carbon particles reunite and give up their motion which is changed back into heat. In other words, a part of the carbon separates out of solution and in so doing gives up its latent heat of solution and prolongs the cooling of the iron. This continues and as the temperature decreases, more carbon separates out and more heat is given up and the cooling is prolonged. It is this giving up of latent heat as the carbon separates out of solution which prolongs the fluidity of cast iron and makes it valuable as a cast product. The act of casting iron into moulds sets into action latent power which makes cast iron so useful. We pour cast iron into a mould; the action of the mould upon the iron reduces its temperature; in doing so it reduces its power to hold carbon in solution, and the carbon in separating out gives up the latent heat which prolongs the fluidity just at the instant when this fluidity is most needed. This, then, accounts for the fluidity.

The second important property of cast iron is its low shrinkage. As iron high in carbon cools from a high temperature, while still in the molten state, the carbon separates out and may be seen flying from the top of the metal. This is readily seen in our casting houses. After casting, however, the outside of the casting soon sets and the carbon can no longer be thrown off as it separates out during further cooling. It is retained in the iron as graphite or free carbon interspersed between the particles of iron. It is this separation of the carbon in the interior of the casting after the outside has set which accounts for the low shrinkage of cast

iron as compared with steel. That this shrinkage is proportionately less, the higher the carbon content, coincides directly with this assumption.

We have still further action of carbon to consider, viz., its action after the solution of iron and carbon is set but is still at a very high temperature. It is known that solid iron at a high temperature will absorb carbon from incandescent carbon; that at a high temperature combined carbon will change to temper carbon as in annealing; that carbon will pass from a piece of high carbon steel to a low carbon steel held in contact with it and both heated to a sufficiently high temperature. These facts prove that when iron is in an apparently solid state, the carbon particles are free to move about and react.

Saniter's analysis of a molten iron containing 4.27 per cent. carbon and cooled slowly gave a combined carbon of 1.22 per cent. and a graphite of 3.05. This would indicate that the amount of carbon which pure iron nominally holds in solution in the solid state is about 1.20.

We have before noted that the greatest amount of carbon which could be held in solution was 6½ per cent, and this only under maximum conditions of purity and temperature. The saturation point of pure iron for carbon varies then between 6½ and 1.22 according to the temperature, and as an iron saturated for a certain temperature cools below that temperature carbon separates out until when the iron sets it holds approximately 1.20 per cent. carbon in solution. The amount of heat evolved depends upon the temperature and the amount of carbon in an iron-carbon solution when it begins to cool.

We have assumed in this instance that the iron was allowed to cool slowly. If it was cast against a chill and the heat immediately removed, all the carbon could be prevented from separating from solution and thus from giving up its latent heat. The fact that the same iron when chilled and when allowed to cool slowly produces such a different structure indicates that the latent heat of solution which is held by the quick cooling in the first case and in the latter is allowed to separate is a very strong factor in determining the character of cast iron. We can draw many examples from everyday practice to show the effect of this evolution of heat by saturated iron in cooling. If we allow two irons, one with 4 per cent. carbon and the other with 2 per cent. carbon, both with low silicon, to cool

slowly, one will have a grey fracture and the other a white fracture. In the former example the heat evolved by the 4 per cent. less 1.20 per cent. or 2.80 per cent. carbon in separating from solution so prolongs its cooling as to allow for a separation of graphite. In the latter the 2 per cent. less 1.20 per cent. or .8 per cent. carbon does not evolve sufficient heat to accomplish this. Slow cooling then is absolutely necessary in producing grey iron. The 4 per cent. carbon iron when cast against a chill gives a white iron, but when allowed to cool by itself the latent heat given up by the separation of the carbon from solution prolonged the cooling and grey iron resulted. The 2 per cent. carbon iron even when allowed to cool by itself produced a white iron.

The high specific heat of carbon has its effect upon the rate of cooling of cast iron. Let us look for a moment at the atomic heat calculation. The specific heat of carbon at low temperature is .198; at 1800° it has been found to be .459. Figured from an atomic heat of 6.3 the specific heat should be .525. If the specific heat rose in proportion from 1800° upward as it did from low temperature to 1800° F. we should have carbon with a specific heat of .525 at a temperature of about 3200° F. If we assume the temperature of our molten iron to be 2600° F. and the temperature at which further separation of the carbon as graphite or temper carbon ceases to be 1800° then we have 800° in which the cooling of the iron effects the condition of the carbon and hence the quality of the iron. Let us assume the specific heat of the carbon in passing through these degrees of temperature to be .5, the per cent. of carbon in our iron to be 4 per cent., the specific heat of the iron to be .11, and the per cent. of the iron to be 96 per cent. The difference in specific heat between the carbon and iron would be .39, or the excess in the amount of heat necessary to raise the unit of carbon one degree over the unit of iron would be .39. Hence in cooling there would be .39 times 4, or 1.56 heat units evolved over the normal amount which would be evolved by 100 per cent. of iron. In other words, the heat evolved by the carbon in cooling would decrease the rate of cooling of the iron and carbon by about one-seventh. When one considers the great changes which a small difference in temperature makes in the structure of cast iron the importance of this difference in the rate of cooling will be appreciated. The rate at which iron cools effects the structure of soft iron more especially between its casting temperature and about

1800°. With hard iron, however, the rate at which it passes through the degrees down to 1200° has an effect upon the ultimate composition of the iron. No attempt has been made to make this calculation other than approximate. My object in introducing it is to show how the high specific heat of carbon delays the cooling of the iron and gives further time for the separation of carbon, and hence the evolution of latent heat.

I have previously alluded to a second factor which has an important effect upon the properties of cast iron. That factor is silicon. I have shown that carbon in separating from solution prolonged the fluidity of cast iron, in fact gave to cast iron the properties of a cast product. We then assumed a pure iron with carbon its only impurity. In practice this is never encountered, and while many irons of low silicon have an application as cast iron, yet in all cast irons silicon plays an important part. Pure iron under maximum conditions is said to dissolve about 23 per cent. silicon. Iron will then dissolve about 3½ times as much silicon as carbon, and, moreover, carbon and silicon each reduce the solidity of iron for the other by an amount which is proportionate to their solubility. For example, an iron containing 23 per cent. silicon would dissolve no carbon, while an iron containing 6.67 per cent. carbon would dissolve no silicon. Proportionately an iron containing say 10 per cent. silicon would dissolve 3.8 per cent. carbon, etc. It must be remembered however that this would be under maximum conditions as to heat and purity. The high point of solubility of iron for silicon and carbon in the best brands in the United States is about 17. This does not mean that the sum of the silicon and carbon percentages ever reaches 17, but inasmuch as iron absorbes about 3½ times as much silicon as carbon before it becomes saturated, the 17 is the silicon percentage plus 3½ times the carbon percentage. Irons for soft foundry work which run 15, when figured in this manner might be called rich, 15½ very rich, and 16 excellent, while 17 is exceptional and very seldom seen in ordinary foundry iron. The amount of carbon which a pig will contain when it comes from the cupola depends largely upon the amount of silicon. Silicon is chiefly useful as a softener, that is, as a producer of graphitic carbon. Iron will dissolve silicon more readily as shown by the greater amount it will dissolve probably due to the fact that the silicon molecule is simpler and more readily broken up than the complex carbon molecule and that it

probably contains a much less number of atoms to the molecule.

We have quoted Saniter's experiment to show that a high carbon iron cooled slowly retained in the solid state 1.20 per cent. combined carbon. From this we conclude that the solubility of solid iron for carbon is about 1.20. If we assume this to be true, and our ratio of 3½ to 1 holds good, then an iron containing 4.20 per cent. silicon cast under the same conditions as Saniter's experiment could hold no carbon in solution in the solid state. This we find to be essentially true in practice. Figuring in the same manner, an iron with 3 per cent. silicon would retain approximately .3 per cent. combined carbon; an iron with 2 per cent. silicon .6 per cent. combined carbon, and an iron with 1 per cent. silicon about .9 per cent. combined carbon. These results are sufficiently close to our actual experience to indicate that our assumption is correct.

The specific heat of silicon is .20 and thus the silicon retards the cooling to a certain degree on account of its specific heat. The 1.20 per cent. carbon held in solution in the solid state by iron containing no silicon may be forced from solution by silicon. The latent heat of solution of this carbon will prolong the cooling of the iron and give it fluidity while the fact that the combined carbon has been changed to graphite will lend softness to the iron. This last 1.20 per cent. combined carbon which is forced from solution by the silicon separates at or near the solidifying temperature and gives up its latent heat just when it is most needed to prolong the cooling and increase fluidity and softness and decrease shrinkage. High carbon irons are always low silicon irons, and high silicon irons are always low in carbon. It would be possible to have a high silicon low carbon and a low silicon high carbon iron of exactly the same hardness. The proportion of carbon to silicon is determined by the class of work for which the iron is intended. The difference in effect of carbon and silicon upon iron is very marked. It is this difference which gives carbon the advantage over silicon as a softener for cast work. No definite figures could be laid down as the best proportions to use of carbon and silicon for various grades of work. One thought should, however, be remembered. Silicon in iron is not a desirable factor. The per cent. of silicon used should be just sufficient to force from solution the amount of carbon desired in the free state in the work in question and to furnish the requisite fluidity for casting it.

The effects of phosphorus, sulphur and manganese and their

action on the carbon-silicon ratio should have a place in the paper but time prevents my discussing them at this present moment.

"MACHINE CAST SANDLESS PIG IRON IN RELATION TO THE STANDARDIZATION OF PIG IRON FOR FOUNDRY PURPOSES."

This paper read by Mr. Edgar S. Cook, at the Water Gap meeting of the American Institution for Testing Materials, is a most valuable contribution to foundry literature. The paper gives considerable general information concerning blast furnaces, it compares machine cast with sand cast iron, and shows the advantage of the former, especially when sold by analysis. While speaking of blast furnaces Mr. Cook called attention to the fact that "the modern blast furnace with its daily product of from 400 to 600 tons of pig iron has been a gradual growth, and becomes a possibility only through the accumulated experience of intelligent and educated managers, capable of applying the teachings of science and at the same time thoroughly trained by a severe apprenticeship in the practical everyday routine of actual working." Our attention is called to the difficulty which surrounds the production of uniform pig iron by blast furnaces and analyses are given which show the variation in the casts of sand cast pig iron. In contrast to this the advantage of machine cast iron is made prominent by several tables of analyses showing the even quality of that iron. This is explained by the fact that the iron is tapped from the furnace into ladles and then poured into machine pigs. One of the great difficulties in supplying iron on analysis has been to obtain a product which would sample uniformly by the maker and consumer. Mr. Cook points out that the mixing in ladles and casting in machine produces a product which is so uniform that a variation in sampling is improbable. The other chief advantage of machine cast iron which is mentioned is its freedom from sand. This is of considerable advantage to the consumer for two reason. First the cupola does not have to take care of the excess of sand, and the machine cast iron is melted easier. Mr. Cook cites the fact that the shell of the pigs are sometimes found intact in cupola bottoms, as an instance to bear out the latter statement. He contends that the chief advantage of machine cast iron comes to the customer and states that while the original idea in the casting machine was to save labor in

the casting house, it has been found that the cost of maintainance and repair more than counterbalance the saving in labor. The actual amount of pig iron obtained per ton of ore by the machine cast method is less than under the old regime. In the sand cast iron the amount of sand on the outside of the pig was sold as iron, and the allowance made for such sand was insufficient to counterbalance this. The customer is therefore getting more iron, pound for pound from machine cast iron than from sand cast iron.

The aptitude of founders in accepting machine cast iron was favorably commented upon by the writer. Under the head of "specifications," the article states that it has been only within recent years that the furnace has been able to select different casts to suit the specifications of the customers, and that this has been made possible by the aid of the chemical laboratory. Mr. Cook further states that all indications point to the substitution of analysis for the old time grading by fracture. He holds however, that it is more important for the foundryman to know the exact composition of his iron, than it is that this iron should fall within set specifications. "With accurate knowledge as to requirements and more positive information as to the composition of pig iron there will doubtless be a smaller percentage of loss of defective castings; the castings themselves will be better adapted for the purpose designed, and the causes of defective work can be more definitely located."

The danger of carrying the matter of specifications too far is mentioned and the recommendation made that specifications be as liberal as possible and still meet the requirements of the work for which the iron is bought. Too close specification might call for an increased price which would more than counterbalance the advantage of buying by analysis. The lack of knowledge on the founder's part in sending out impossible specifications together with the improper methods of sampling used by some founders are alluded to as drawbacks to progress in the matter of grading by analysis.

In closing, Mr. Cook distinguishes between machine cast sandless and sandless pig iron. The former mixes each cast by tapping it into a ladle before casting. The sandless pig simply replaces the sand pig with iron pigs but *the product is no more uniform*.

This paper of Mr. Cook's should give the founder a clearer understanding of furnace conditions and help him to appreciate the

difficulties under which the furnace man works in supplying iron on analysis. I do not wish to convey the idea that there is anything mysterious about the blast furnace. The paper states to the contrary and calls attention to the fact that modern up-to-date blast furnace practice makes possible the production of a superior and more uniform grade of pig iron. There are still furnaces run with antiquated out-of-date methods and appliances. It is naturally impossible for them to compete with a modern furnace in supplying uniform grades of iron. It is the representatives of such furnaces who try to impress it upon the founder that the blast furnace is a very uncertain quantity and expect the foundryman to suffer for their fault in not introducing more modern practices.

In comparing the sandless and sand cast pig iron I consider that Mr. Cook has stated very moderately the advantages of the machine cast iron for foundry work. The saving in iron and the saving in fuel are important items which appeal to the founder and will lead in the near future to a demand for further extension of machine cast iron. The saving in fuel is considerable, for in melting sand cast iron enough heat must be furnished to melt the sand on the outside of the pig and keep it fluid enough to pass off as slag. The machine cast iron with its higher combined carbon melts at a lower temperature than does the sand cast iron of the same silicon. There appear to be but two objections to machine cast iron to offset its many advantages. The first, which is alluded to by Mr. Cook, is the difficulty in piling it, and the second is its tendency to clog or hold up on account of its smoothness and the compact way in which it may be packed into the cupola. This latter objection may be easily overcome by taking care that the scrap and pig are well mixed and thus prevent too many pigs of the machine iron from coming together and bridging.

In referring to specifications, Mr. Cook has touched upon one of the live topics of foundry practice. His word of warning that the unreasonable demands made by buyers may hurt advancement in this line is very timely. Great judgment should be used in this matter, especially at so critical a time in the development of specifications. The buyer and seller have both much to learn, and conservative specifications fulfilled are much more satisfactory than impossible ones which cannot be met. In buying iron on analysis, a furnace which normally runs high in phosphorus, sulphur or man-

ganese should not be asked to fulfill a low phosphorus, sulphur or manganese specification. Neither should a furnace which runs with low phosphorus or low manganese ores be asked to fulfill high phosphorus or high manganese requirements. A furnace will often take an order trusting that the differences will not be sufficient to warrant the condemning of the iron and thus cause contention. The buyer would not go to a shoe store to buy hats. There are certain distinct characteristics about different brands of iron. If you want high phosphorus iron, send your specifications to those who sell high phosphorus iron, and vice-versa. Certain furnaces normally make iron running from 3 to 4 per cent. in silicon, other furnaces occasionally make such iron. It is much better at the same price to place the order with the furnace which normally produces that iron, than it is to wait until some other furnace by accident happens to run on this grade.

Buying on specification should not be allowed to interfere with the economical purchasing of iron. If a bargain is offered in an iron which runs somewhat higher in certain elements than is suited for your work, other iron may be bought which runs sufficiently low in those elements and thus bring down the percentages to the required analysis and allow you to take advantage of the offer.

I take issue with Mr. Cook in but one statement in his paper, he holds that a founder is more desirous of knowing the composition of his iron, than that it run within certain specified limits. It is a great advantage to know just how your iron is going to run. The most economical brands whose analyses will make up the required composition should be selected. There will then be no pile lying around the yard eating up interest which can only be worked off in small quantities.

One of the principal difficulties now standing in the way of the successful buying of pig iron on analysis is the different results obtained by furnace and foundry chemists on the same lot of iron. The increased use of the casting machine should remove the variation difficulty as far as the iron is concerned. The adoption of standard methods for sampling and analyzing should remove the analytical difficulties. Altogether it looks as if there was a bright future for the buying and grading of iron upon analytical specifications.

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INFLUENCE OF THE CASTING TEMPERATURE ON ALLOYS.

Iron and Steel Institute, May. Mr. Percy Longmuir, a Carnegie research scholar, has recently made a series of investigations on the influence of varying casting temperatures on the properties of alloys, which should certainly lead to a better understanding of the subject, at least so far as brasses and bronzes are concerned. He cast a number of metals, among them cast iron of various kinds, and in such a way that the first set of bars was cast with the metal very hot, the next set with the metal at normal temperatures, and the last set with the metal as cold as it would stand pouring. He then subjected the bars to a series of chemical, physical, and microscopical tests. So far as the general appearance is concerned it is better to cast at medium temperature, rather than at high heat. The metal becomes denser as the casting temperature is lowered, and while hot metal makes more perfect looking castings, there remain numerous hard crystals which give much trouble in the machine shop subsequently. Special care should therefore be taken in the foundry to get out high grade material, even if at a greater cost, so that the machine shop may not lose time and throw money away afterwards in greater quantity.

CHILLED ROLLS.

The Iron Age, April 23 and 30. The best known authority on chilled rolls is undoubtedly Mr. E. B. V. Luty, and he writes very interestingly on his favorate subject in the two issues of the Journal mentioned, The annual consumption of rolls is about 5,000, costing about $1,000,000. In rolling tin plate, this material being very thin, naturally requires hot rolls, the temperature being between 650° and 800° F., in their central portion, and shading off to lower temperatures in the neck. This introduction of variables of temperatures makes the life of the roll so problematical. Mr. Luty believes that all these difficulties can be solved readily, provided the expense connected with the experimental work be not feared, it being necessary to make working tests to destruction. The analysis of the ideal chilled roll of English practice is now given, running a little higher in manganese and carbon than is the case in this country, while the silicon is low. In our American rolls the silicon runs about .70 to .90, manganese .20 to .40, phosphorus about

.400, sulphur about .05, and total carbon 3.25 %. It is a difficult matter to prescribe for special cases in making rolls. It is always best to make a good average mixture and later on when thoroughly acquainted with this branch of the work, special lines may be followed up with greater certainty of success. There is always a contest between the maker and user of chilled rolls, the first trying to make as good a roll as possible, his reputation being involved; the last does not always use a roll wisely. The life of a roll should be between 90 and 120 actual working days for tin plate and ordinary steel rolling. The occasional breakage of a roll is not now considered so great an evil, provided a great output is secured before it does go. The standard tin plate roll is 26″ diameter and 32″ long in the body. The breaking of a roll may come from casting strains, either originally in the roll, or caused by variations in temperature and consequent unequal expansions. Then it may come from pressure of the metal rolled. Also irregular working and consequent heat strains. Mr. Luty finally devotes considerable attention to the detailed study of heat strains in rolls, and their solution. This most excellent part of the paper is best studied in full by those most interested, from the original source.

DESULPHURIZING FOUNDRY IRON.

The Iron Trade Review, September 10. Mr. Walter J. May writes about ways and means for overcoming the deleterious effects of sulphur in foundry iron. Obviously the best method would be to use only materials comparatively free from this undesirable ingredient, and indeed it becomes a question whether it is not better to spend the extra money in good coke and pure iron in the first place, than to do it afterward in the machine shop. Where there is no choice, Mr. May recommends that the coke be washed in lime water, which when thus saturated and dried can be pushed for quick melting with good results. Managanese is the best medium to effect a removal of sulphur when in considerable quantities. Use 1 to 2 per cent, in addition to that carried in the iron. The recent experiments of Mr. Reusch, of Witkowitz, are quoted. (They were reviewed in these colums some time ago, managanese ore being used as a flux in the cupola, cutting out the sulphur from the castings almost completely.)

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INTRODUCTION TO THE INSTRUCTION PAPERS ON FOUNDRY CHEMISTRY.

The object of this series of papers is to present in an elementary way the principles of the chemistry of iron as applied to foundry practice. No attempt will be made to give advanced instruction to expert metallurgists. I shall rather endeavor to bring out in as simple a manner as possible those facts which the beginner must acquire if he would understand how to use chemistry in the mixing and melting of iron. In presenting these facts, three distinct classes of readers will be kept in mind by the writer, The foundryman, who, although he may have no direct hand in the mixing or melting of his iron, desires a general knowledge of the methods which are used and the principles which underly them. The foreman, who has hitherto mixed his iron by the fracture method. Finally, the molder and the apprentice, who both have a common interest in obtaining a better understanding of cast iron, and the methods of melting and mixing it. The foreman who does not do the mixing should have a knowledge of the possibilities and limitations of cast iron. The molder or the apprentice, from whom our future foremen must be drawn, should acquire as much knowledge as possible of what is frequently the foreman's chief difficulty. A knowledge of the nature of cast iron is of great assistance in determining the methods of gating, feeding, and the temperature of pouring, the necessity of risers, and the nature of the sand and blacking used. The difficulties experienced by chemists just commencing foundry work will be considered in the following papers.

In endeavoring to include in one series of papers three distinct classes of readers, some material must be included which may not be of interest to all.

At the commencement of each paper a simple definition will be given of all terms used in the paper, the meaning of which might be in any way obscure to any of the readers.

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INSTRUCTION IN FOUNDRY CHEMISTRY.

By HERBERT E. FIELD.

PART I.

General Instruction on Cast Iron. Definitions.

Chemistry—is the science which deals with the composition of material things. The *Chemistry of Cast Iron*, then, is the science that deals with the composition of cast iron.

Element—An element in chemistry means any kind of matter which has not been decomposed or broken up into any other matter.

Properties—There are certain definite characteristics which a chemical element or compound posesses. These are known as its properties.

Mixture—When two or more substances are put together and each retains its own properties, it is known as a mixture.

Alloy—An alloy is what may be termed an indeterminate compound. The metals making up an alloy mix in varying proportions and not in exact amount as in the case of a true compound.

Compound—A compound in chemistry is a union of two or more elements in which the elements lose their old properties and take on a new set of properties which may not bear the slightest resemblance to the properties of the elements which make it up.

Metal—A metal is an elementary substance having a metallic lustre. It is a conductor of heat and electricity.

Metalloid, or Non-metal—Under this head are classed those elements which have no metallic properties, or at least which have them in but a slight degree.

Annealing—As applied to iron, this means the maintaining of the iron at a temperature sufficiently high to accomplish the desired results. It usually involves slow and very even heating to the required temperature, then a prolonged heating at that temperature and finally a slow even cooling to ordinary temperature.

Hardness—By this term is understood the resistance offered by a body to a separation of its particles. The hardness of a body may be said to be its capacity for resisting abrasion and penetration.

Impurity—This term as used in cast iron literature is applied to

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those elements other than iron which go to make up cast iron. The principal ones of which are carbon, silicon, sulphur, phosphorus, and manganese.

Divisions of Cast Iron.

In a broad sense the term cast iron includes the two divisions, pig iron and the cast iron of our foundries. This paper will principally deal with the latter division.

Sub-Divisions of Cast Iron.

Cast iron may be divided into three sub-divisions; grey iron, chilled iron, and malleable iron.

Malleable iron is a form of cast iron which when cast has a white fracture and is very hard. Before it is used it is subjected to an annealing process which renders it soft.

Chilled iron is a division of cast iron so named because it is cast against some substance like a large body of iron which cools that part of the iron next the chill very rapidly, giving it a hard, white structure. The part away from the chill cools slower and is much softer.

The difference between malleable and chilled iron is that the malleable iron when cast into a sand mold is white and hard. Chilled iron has these same properties because it is cast against a chill which hastens the cooling. Malleable is hard only in its first step and is useful only after it has been annealed.

Grey iron includes those grades of iron which when cast into sand molds have a grey fracture. There are almost an innumerable number of different grades of grey iron. It is used for castings $\frac{1}{8}$" thick and for anvil blocks and hammers weighing 50 tons and over.

Divisions of Grey Iron.

It would be impossible to give a name to all the different grades ot grey iron. In order to simplify our study, however, we will arbitrarily divide it. The stove plate grades include stoves, radiators, etc.; the light machinery grades, harvesters and cotton machinery; the heavy machinery grades, large planers, lathes and engine castings; the high strength grades, such as are used for certain classes of work which require a high strength. Besides these there are a number of special grades as cylinders, ingot molds, acid and alka-

li resisting castings, electrical castings, etc. For each of these different grades a different quality of iron is required. A knowledge of the iron suitable for one grade is but a small part of the whole. An experience gained in one class of work is often misleading when applied to another class. This has lead to all sorts of confusions and contradictions in cast iron literature. A writer whose experience has been w holly with stove plate may make certain observations and publish them, another whose experience has been with heavy machinery castings may do likewise. To one not familiar with both classes of work, these statements might contradict each other. This condition of affairs makes it difficult for the beginner to make a study of cast iron from current and past literature.

Properties of Cast Iron.

There are four properties which make cast iron valuable and account for its extensive application. These are, first, its fluidity, second, its low shrinkage, third, its softness, fourth, its strength. By combining these different properties we are able to obtain a product suited for the various kinds of work.

For the stove plate grade fluidity is the most important property. The iron must be fairly soft, but strength and shrinkage do not play the important part that they do in other grades.

In the light machinery grades we must have a certain amount of fluidity. Heavy and light portions of castings side by side introduce a problem not generally met in the stove plate grade, viz., shrinkage. The iron must be soft and a certain amount of strength is required.

In the heavy machinery grades fluidity is no longer the paramount issue. Low shrinkage and softness are the properties most necessary in the heavy machinery of today. Low shrinkage because of the tendency to combine into one casting heavy and light parts formerly made in several pieces, softness because the expense of machining is frequently the important item in the cost of a machine. Strength can frequently be sacrificed for softness, as the weight required in this class of work often covers this fully. There are different combinations of iron which would give the required softness and shrinkage and it is policy to select, at an equivalent price, the strongest of these.

In high strength irons, strength should be made the principal aim. Shrinkage must be taken care of in the construction of the

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pattern, or by the use of chills or risers. Such irons, however, must be kept as soft as possible and still give the desired strength on account of the cost of machining.

We have, then, four general classes of grey iron, with the characteristics which they must possess :

1. Stove plate and similar castings. Necessary property, fluidity.
2. Light machinery. Necessary properties, low shrinkage, fluidity, and softness.
3. Heavy machinery. Necessary properties, low shrinkage and softness.
4. High strength irons. Necessary properties, strength and softness.

Structure and Composition of Cast Iron.

There are two factors which give the above mentioned properties to the various classes of cast iron. First, its composition. By this we mean the amount of the impurities, as carbon, silicon, sulphur, phosphorus and manganese, which they contain. Second, the rate of cooling. By this we mean the time taken by the molten iron to become a solid, and to cool down after it becomes a solid. The longer the iron takes to cool, the softer will it be. This is shown by the difference in hardness in a heavy and light casting poured from the same ladle. Some kinds of cast iron, if poured into a casting 3 inches thick would give a soft casting, which would be easy to machine, but if poured into a casting ¼ inch thick it would be solid white and so hard that it would be impossible to machine it. The former would retain its heat longer and cool slowly. The latter would cool quickly and hence be very much harder.

Of the elements which go to make up cast iron, iron is considered to be a metal; manganese has some metallic and some non-metallic properties, while silicon, sulphur and phosphorus are non-metals, or metalloids.

The purest iron which we have in commercial form is called wrought iron, while together with carbon, it makes up the various grades of steel. The higher the carbon, the harder the steel. The amounts of carbon and steel run from .1 of 1 per cent. to 1½ per cent. Pure iron as wrought iron has no application as a cast product. It melts at too high a temperature and when melted it flows sluggishly, sets quickly, and shrinks badly, in fact it is wholly un-

fitted for casting. Alloyed with small amounts of carbon, silicon, manganese, and aluminum, iron is used as a cast product, called cast steel. This may be cast into molds; it melts at a lower temperature than wrought iron, is more fluid and shrinks less.

Iron mixed with larger percentages of carbon, silicon, etc., makes up our cast iron. This has a much lower shrinkage than steel, melts at a lower temperature, is much more fluid, in fact is much better suited for a cast product. The only difference between the sluggish high shrinkage iron and steel, and the fluid, low shrinkage cast iron is in the amounts of the impurities present. Carbon and silicon may be said to be the most important of these impurities; phosphorus and manganese are very beneficial in certain grades of work, but sulphur is in almost all cases a harmful factor.

FOUNDRY MANAGEMENT.

Edited by JAS. A. MURPHY, 114 W. 20th St., Erie, Pa.

Discussions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Murphy.

SOMETHING ON CHILLED CASTINGS.

Several of our foundrymen know to their sorrow the many ills various kinds of chilled castings are heir to, and when one of these self same foundrymen resorts to asking questions through the medium of one of our dispensing periodicals which aims at compounding big chunks of foundry wisdom, he must be hard pressed indeed. In a recent issue of one of these erudite journals, a subscriber was told that he could increase the depth of the chill on the bottom of his casting by putting a large riser on top, and that was the only way it could be done. The editor in question must have either been in a great hurry, to put it in the most charitable light, or he was in extremely low spirits, for he neglected to add that the chill may be further slightly increased by the simple but effective process of shaking pepper and salt on top of the riser after the casting had set.

ACID-PROOF CASTINGS.

It is a funny thing to follow the rounds of an article through the press of the country. We have before us a lot of clippings of an article entitled Acid-Proof Castings, which is copied almost word for word from our *Journal* of November, 1902, Part III, page 3. In the first place it was an abstract of the paper of Mr. Carl Rott, of Halle, Germany. It was reviewed by us for the benefit of our Foundrymen, and has since been copied without credit almost everywhere. As it is we feel quite flattered, inasmuch as the translations and reviewing of our editorial staff is at least appreciated enough to be appropriated. Since, however, the article has gone round the circle, we wish to add that to follow the advice contained, namely, that the composition should be about as follows:—

Silicon . .	0.80 to 2.00
Phosphorus .	0.4 to 0.6
Sulphur . .	0.02 to 0.03
Manganese .	1.0 to 2.0
Total Carbon .	3.0 to 3.5

is not so easy a matter, many of the foundries making acid kettles

and the like articles, having to change their methods and prices very materially. The mixtures must be charcoal irons mostly, and would have to be melted in the air furnace.

CUPOLA WONDERS.

We recently had the pleasure of visiting a neighboring foundry that had installed a regular "cracker-jack" of a cupola. The foreman informed us that it worked splendidly—melted about thirty tons an hour, with iron at a white heat all the way through. He could, however, not understand the fact that when bottom was dropped, two car wheels that had been put in with the first charge, came out without being melted. It is hard for an ordinary plebian to venture an opinion on a such knotty problem when in conversation with high foundry lights, and we therefore refrained from going on record. We will add that the foreman in question never got over the trouble, but is just now, in fact has been for some time, hunting a job.

THE CAST-IRON CLAMP.

Mr. F O. Reman, in a recent issue of the *Iron Trade Review*, says "that cast iron is the only clamp material to stand shop stress and strain. Cast iron will stand some abuse and spring back. If it gets too much it breaks. Then you get another casting and your clamp is as good as new. Had it been made of steel or malleable it would have bent. You would not throw the bent piece away and you might not have the courage to bend it back. These castings bend back awkwardly and have a mean manner of breaking when nearly in shape. Then you continue to use that clamp for what it is worth. That bent clamp, only half a tool, is an eyesore that shortens the outlook of the craftsman who has to fuss with the cripple."

He is referring principally to the clamp in the machine shop, but his words are equally applicable to the foundry. Several futile attempts have been made to put the common cast iron clamp out of business, but like its brother, the cast iron gagger, it will stay with us several years yet, or until something better can be made at anything equalling its low first cost.

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PUTTING IN THE CUPOLA BREAST.

A recent article in the *Tradesman*, from the nimble pencil of Mr. E. H. Putnam (see our Journal, Nov. 1902, Part III, page 38) goes to considerable length in describing the very simple operation of putting in the cupola breast. Now we always considered Mr. Putnam's way of building the breast after the cupola is lighted as a case of putting the cart before the horse. It is better practice to build the breast before anything is put into the cupola at all; when the operator can see just what he is doing, and in every case have a better job and better results throughout the heat. Metal freezing in the tap hole, bunging it up as well as the spout, and blowing the sparks over a large area in front of the cupola are common troubles in even some of the oldest, and in some respects well regulated foundries. There troubles can, to a large extent at least, be remedied by a little care and forethought. The best way to prevent metal from freezing in the tap hole, is to not let it get in there. Is there any more reason for leaving the tap hole of a cupola open during the melting operation than there is of an air furnace? Nobody thinks of leaving the tap hole of an air furnace open. We know a young foundryman who makes a practice of closing the hole, just before putting on blast, with molding sand. The blowing out of sparks, chilled tap holes, or bunged up spouts, are things unknown in that foundry.

GAINING EXPERIENCE.

With a whoop and a roar over things out of the ordinary, the daily press announces that the scion of a well known New England family has entered his father's foundry as an apprentice to learn the intricacies of the trade. The action of the young man is praiseworthy in the extreme, for though the posessor of millions of dollars and a sheepskin from Yale, he is not above acquiring through hard work a thorough hold on the business from whence he derives a lovely income. He probably also recognizes the fact that the next generation of foundrymen will be the best ever known, and that the chances are twenty to one that they will be supplied by, and trained in, the foundry, which for our purpose is the best of universities. It is good to supplement a university degree with a post graduate course in the sand heap, and on the cupola platform.

THE IDEAL FOREMAN.

The Foundry, Sept. Mr. Paul R. Ramp, who comes as near to an ideal foreman himself as any man, writes very earnestly and convincingly on the above topic. To sum up his arguments, the ideal foreman should be a practical molder, and familiar with all the details of foundry work. He must make men feel that he has a personal interest in them. In making changes in the shop, he should begin with the small things first, especially those which will show his ability to grasp the situation properly. He should be in close touch with the men at all times, leaving most of the office work to his clerk. He must know which men to drive, and which to lead. His dignity must be so that he will not ruffle it by carrying a core box or pattern across the shop. He must not object to helping a molder, when he can be of assistance to him. He should be pleasant tempered but strict. Such a man will succeed.

THE FOUNDRY MANAGER.

Engineering Magazine, June. Mr. Robt. Buchanan closes his excellent series of articles on the modern foundry by discussing the qualities of the foundry manager. Two things are required of this individual: Skill and Character. He should be able to cut costs wherever possible in the proper way, and be always resourceful. The fact that reduction in expenses brings about increased wages is not so paradoxical as Mr. Buchanan supposes, for nothing on the molding floor is more apparent than that the man who puts up the most good work and gets the highest pay in consequence, is a money-saver to the concern. The introduction of the premium system is not only difficult because the men are afraid of it, but the labor organizations have a cardinal principle which aims at leveling all classes. Working under premium contracts would seem to them to make a preferred class. Short date balancing of cost accounts are recommended as being features in keeping with straight running, for it is better to know at once how things are tending, than at long intervals. Apprentices should be well trained, and careful foundry managers always see that this is looked after properly. The foundry manager of today must be well posted on cause and effect, besides knowing the ins and outs of the business. He must be able to use science whenever it will help him accomplish results.

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FOUNDRY MANAGEMENT.

The Foundry, June. Dr. Edward Kirk, in another of his carefully written articles, takes up foundry management on very broad lines. The jobbing foundry is still very far behind in the matter of economics, which means lack of good cost systems, which the younger element is striving to overcome in all sorts of ways. Many foundries still have no way in which there can be determined the cost of melting, since no scales are provided to weigh the components of the cupola charges. Then again the blast may be put on before the molders are ready for pouring, or worse still, the molders may be ready long ago, and loaf around before the blast goes on. Here is a chance to improve on the usual lack of system. It is always best to put on the blast at the regular time, whether the molders are ready or not, as they all shape their work accordingly anyhow, and the longer you wait, the longer they loaf when they consider their day's work done. The condition of the floor comes up next. It is important to have proper gangways, and each man his own place to work in. This saves time and high priced labor every time a job changes. Even in half of our high priced "modern" foundries we find this trouble, the travelling crane being an actual necessity to get iron when needed, as it could never be carried over the obstructions on the floors. The floors should be level, the gang ways wide, the windows clean. Good ventilation and heating systems are a great help in the way of efficient foundry management. The cupola should be high to utilize all the heat possible. The foreman should do no molding but should see that the men do. Twenty-five men will give a foreman enough to do to look after them properly. Dr. Kirk records an example where foremen were placed over each ten men to see that everything went off right. This proved a great success as double the casting were produced by the same number of men, and they were also of better quality.

HANDLING CUPOLA CHARGES.

The Foundry, June. In an editorial, attention is called to the modern tendency toward greater economy in handling the charges for the cupola. The reduction of fuel for melting purposes has gone on as far as it is safe, too much of this meaning heavy losses in castings. By the method of carrying the charges up to the

platform, and into the cupola, an additional economy is sought, and considering the comparatively low cost of industrial railways, there is no reason why the cupola charges should not be made up in the stock yards, and conveyed into the cupola charging doors direct. Those who were present at the Milwaukee convention of our Association will recall the excellent example of this method in the new plant of the Allis-Chalmers Co.

MANUFACTURING INGOT MOLDS.

The Iron Trade Review, August 6, gives an illustrated article on the new shop of the Thos. D. West Foundry Co., from which the following is extracted for the information of our members who may be interested in continuous founding:

The present practice in the manufacture of ingot molds for Bessemer and open-hearth work is as follows:

The molds and cores, being first rammed and finished, are placed in a drying oven or covered pits and left over night to dry. The next day they are taken from the drying ovens, assembled on the casting floor and poured, this occupying all the second day. During the night or early in the next morning they are shaken out, and later cleaned, chipped and loaded for shipment, thus occupying 48 hours in the process of making a mold. The flask in which this mold has been made has been employed the same length of time before it can be used again, and to cast any particular mold at the rate of one in 24 hours it is necessary to provide two flasks, since one flask will yield but one mold in 48 hours.

Under the continuous process the Thos. D. West Foundry Co. will employ, a mold will be turned out in less than 8 hours so that 3 molds can be obtained from one flask in 24 hours. This makes it practicable to use special machined flasks for small as well as large orders (giving a much better casting) in a foundry doing a general mold business, instead of the jobbing or pieced out flasks under the usual methods of making molds.

In introducing continuous operation in a mold foundry the first step is to abolish a permanent casting floor, which is occupied first by the closing of the molds, then by the pouring, then by the cooling; later by the shaking out; and finally the floor must be

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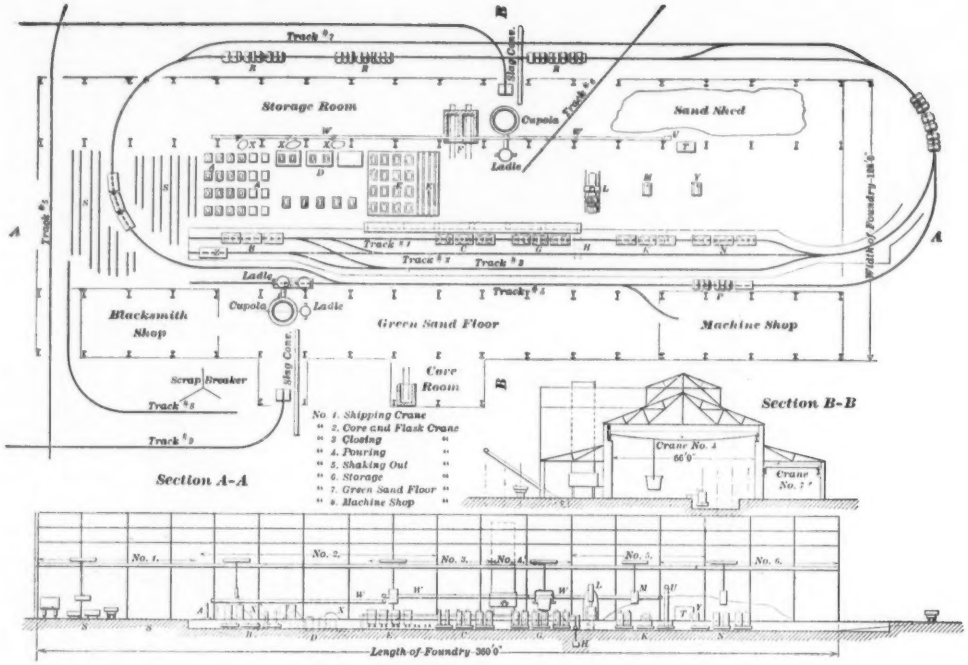
Track #7
Storage Room
Cupola
Track #4
Sand Shed
Ladle
Track #1
Track #2
Track #3
Ladle
Cupola
Ladle
Track #4
Blacksmith Shop
Green Sand Floor
Machine Shop
Core Room
Scrap Breaker
Track #5
Track #6
Section A-A
No. 1. Shipping Crane
" 2. Core and Flask Crane
" 3. Closing "
" 4. Pouring "
" 5. Shaking Out "
" 6. Storage "
" 7. Green Sand Floor "
" 8. Machine Shop "
Section B-B
Crane No. 4 66'0"
Crane No. 7
No. 1.
No. 2.
No. 3.
No. 4.
No. 5.
No. 6.
Length of Foundry 360'0"

cleaned up before it can be used again. The practice at the Sharpsville plant will be as follows:

The molds are assembled on buggies and kept moving ahead for the successive operations until shaken out, when the empty flask and core bar are returned on a previously used buggy to repeat the operation, thus avoiding the accumulation and delay incidental to successive operations on one place. The cores are rammed on plain plates at A and dried in from two to three hours without removal. After this they are set into the prints of the bottoms on the buggies at B. The buggies are now pushed by a locomotive up to C. After the cheek parts of the flash are rammed at D they are removed to rack E, where they are finished and dried, the drying requiring from two to three hours' time. The cheek flasks are now hoisted and lowered over the cores at C. A cope and runner box that has been dried in the oven F is placed on top of each flask. After the bottom and copes are clamped to the cheek flasks, the molds are moved up to G and poured.

After the pouring the runner box and cope are removed and the buggies are moved to K where the cheek flask and ingot casting are hoisted together from the buggy to be placed over the pit L. Here by means of a verticle stripper the core bar is pushed out of the ingot casting to drop into the pit. The cheek flask and ingot casting are now hoisted off from the pit and laid flat at M. The uppermost part of the cheek flask is removed with the crane's auxiliary hoist and the ingot mold casting lifted out of the under part of the cheek flask and laid on adjacent ground at Y. The empty cheeks are then assembled and clamped. The bottoms on the buggies having been made up while hot, to be self drying, the cheek parts of the flask are placed back on the buggies in position at N and the core bars lowered inside of them, after which the buggy is transferred to the return track No. 3. When the buggies have been moved down and transferred over to track No. 1 to again be in a position as shown at B, the core bars and cheek flasks are hoisted off the bottoms and placed in position to again make the cores and molds. Dried cores again being set into the bottoms prints, the locomotive Z is brought into action to push the buggies forward as shown.

The sand having been removed from the outside of the hot ingot mold at Y, it becomes necessary, for the comfort of the men, to prevent any accumulation of hot molds at this point. For this

reason the mold is hoisted to a buggy made to hold three or more castings placed at P on the surface track No. 4. This track encircles the outside part of the foundry and on it the buggies are left in numbers as at R to cool off the ingot castings. In the wait here the case sand is removed from the interior of the ingot castings, and after they are cooled sufficiently to be chipped they are moved ahead into the left hand end of the foundry, where they are placed on tracks as S ready for clipping or chipped as they lie on the buggies. They are then hoisted, weighed and placed in cars on track No. 5 for shipment to consignee.

The sand is mixed in the locality where the ingot castings are taken out of their flasks at M and Y, and adjacent to new sand, by shoveling into a disintegrating, riddling and mixing machine T. The sand is mixed to the right dampnes and strength by the addition of new sand obtained from the sand sheds close by, and is conveyed from the mixer T by buckets U aud belts W and delivered ready for use on the mold and core rammer's floor at X.

The plant is designed for 10 molds per hour, each weighing from 3,500 lbs. up, and operating on the continuous plan would produce 240 molds, or from 400 to 1,000 tons a day.

FOUNDRY BACKWARDNESS.

The Foundry, September, in an editorial has it that in no industrial plant, considering the amount of capital invested, is there so much backwardness as in the foundry. Only ten years ago there were hardly twenty-five up to date foundries in the country. Today, we can count any number of first-class shops wherever we look. Yet in proportion to the time spent in studying out improvements much greater changes could have been made. Take the combined foundry and machine shop; the latter invariably gets the best of the equipment ordered. In the foundry lack of appliances compel the management to rely more upon the native skill of the molder than should be the case. The fact that foundry product is crude should not make the proprietor of a shop think it useless to procure the very best appliances. The sharpest foundryman has these appliances and consequently makes comparatively the most money. The time will come when only those who keep their shops strictly up to date, will be in the race.

EMERY WHEEL PRACTICE IN FOUNDRIES.

The Iron Trade Review, September 10, gives the paper on this subject by Mr. Chas. S. Smith. One would hardly think that the selection of an emery wheel is such an important matter. But it certainly is, and some of our manufacturers have realized this fact and have spent much money demonstrating it to their customers. They have developed systems which enable them to supply just what will give the best results for the work to be ground. In the case of heavy castings, where the iron is soft, chipping is preferable, but when hard, a swing frame machine with a 20″x2½″ wheel running at 1,200 RPM gives the best speed for cutting. Always have the stands heavy and the spindles of a large diameter, placing the apparatus on a solid concrete foundation, instead of the usual springing wooden floor. Always use the large diameter wheel, the 24″ being better than the 18″. When a man can lift the casting a 24″x3″ wheel at 1,000 RPM with a 5″ pulley will be found most suited. Plows and other like chilled castings which were formerly considered only possible to be handled by the large grind stone, are now trimmed up with the emery wheel. Mr. Smith gives a number of examples showing the effect of emery wheel work when compared with the planer in the machine shop.

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PATTERN MAKING.

Edited by WM. H. PARRY, 664 East 31st St., Brooklyn, N. Y.

Discussions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Parry

GREETING.

One of the very desirable directions into which the American Foundrymen's Association should branch out is the study of pattern-making. To this end already at the Milwaukee convention some preliminary work was done to arouse a general interest among the foremen pattern-makers present. It was interesting to note that many of our foundry owners and managers present were graduated into their responsible positions directly from the pattern shop. It would appear most fitting therefore that a Section similar to that of the Foundry Foreman be organized. The object of this section would be to create a more friendly feeling between Foremen Pattern-makers through the exchange of ideas and methods, the reading and publishing of papers, open discussions whenever possible, the asking and answering of questions pertaining to the craft; in fact the consideration of everything tending toward a betterment of existing conditions.

In taking the initiative for the formation of this section in our Association, the writer does not greet prospective and present members with any spirit of personal aggrandizement, or has he any claim to superior knowledge, but he is rather a seeker "of ways that are now dark, and tricks not in vain, which the same he would rise to explain." He hopes to discuss some of the objects sought by progressive men whom we all hope to interest sufficiently to become active members in the section and the Association at large, so that all will share equally the benefits to be derived by a spirit of mutual assistance and tolerance that must prevail to succeed in this world.

There is no doubt of the need of this special section in our Association in this age of spirited progress. This is evidenced by the instantaneous success attending the formation of the Foundry Foremen's Section and Association less than a year ago. The beginning was made with a few earnest men, and at present the membership is beyond the wildest dreams of its originators. This

shows conclusively that up-to-date men, in whatever line they may be situated, are thoroughly awake to the necessities of the times. If further proof is wanted witness the formation of the Foundry Foremen's Association in Milwaukee, as a direct result of the recent convention there of the American Foundrymen's Association, the last reports showing the new society to be in a most flourishing condition.

The writer would be most pleased to hear from those in harmony with this proposed Section for Foremen Pattern-makers, and once a sufficient number have expressed their willingness to co-operate, the Executive Board of the American Foundrymen's Association can be counted upon to promptly establish the Section with its necessary officers. The Secretary of the Association, Dr. Richard Moldenke, P. O. Box 432, New York City, will also be most pleased to give all possible information on the subject to those who will drop him a line to that effect.

THE MODERN PATTERN SHOP.

Probably the first paper of its kind ever read before an American audience was that of Mr. Gobeille, of Cleveland, on the organization, maintenance and management of the modern pattern shop. The Milwaukee convention of the American Foundrymen's Association has been rightly congratulated on receiving this notable contribution from a gentleman whose fitness for the task of enlightening us on matters pertaining to the art of pattern-making is unquestioned. Mr. Gobeille is, and has been regarded for many years, the "leading pattern jobber of our country, if not the world."

There are to our mind, however, some sins of omission and possibly commission contained in the paper in question. As it is the purpose of this department to comment freely upon whatever appears in the interest of pattern-making, and it is hoped, be equally freely criticised therefor, a few memoranda are added herewith. Take the equipment of the mill-shop where we do not find a swing cut-off saw handy to the door-way from the lumber room. This is a serious mistake where the economical handling of lumber is considered, as one man can cross-cut a plank with this machine better than two could on a combination rip and cross-cut saw such as

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shown in the plan. We might add that combination machine tools of any kind have no place in other than very small shops.

We fear that Mr. Gobeille complains somewhat without cause of the dearth of really good glue pots in the market, as twin, triplet, aye even sextet gluepots can be bought that are, we think, much superior to the one designed by him, and shown on page 137 of the JOURNAL. We believe this from the fact that an up-to-date pot is an affair with 3/8 inch to 1/2 inch space between the outer and inner pots, these in turn hermetically sealed and placed in a heater. By the use of this device the saving in glue will pay for a twin pot every ninety days, and an agreeable change will be had from the usual ill-smelling and filthy vessel on which the glue burns and collects on the sides. While this double pot device can be termed essentially modern, it has nevertheless been in constant and successful use for over twenty years.

We heartily concur with Mr. Gobeille's sentiments on the trimmer question. His segment machine is undoubtedly a time saver. The pattern-maker, however, who cannot "build up," "lay up," or "glue up" more than twelve and one half courses of six segments each, in nine or ten hours by the "shute," "chute", or "shoot" board route, say 52 inches diameter, 3 inches wide, must be a poor stick indeed, and the foreman or employer who would allow any but the cheapest help to work on plain segmental rings, must be of the same class.

We do not like to dissent with Mr. Gobeille on the gear cutting question, but think that there is something amiss with his information as to the output of other shops, which "is no better than 50 cents an inch of diameter plus face to make teeth in hard wood for ordinary spur gearing, by skilled hand work, at 40 cents per hour," to quote from his paper. We would also think his special machine adapted to cutting spur gear only and with its capacity limited to the stock of cutters on hand for filling hurry orders.

There are many such machines in the East, and while the actual operation of cutting the teeth is fairly speedy, the "setting up," grinding, and selection of cutters is anything but fast work. It may interest Mr. Gobeille to learn that at least in one shop in Brooklyn, gears, both bevel and spur, are cut by machine any diameter and width of face, somewhat cheaper than 2 cents per inch; in fact from the records at hand of all kinds of wheels, including

skew-bevels, the average cost has been only 1½ cents per inch of diameter plus face.

Regarding Jointers, we would say that the market will supply them up to 30 inches, or 6 inches wider than Mr. Gobeille supposes. Then about the price of fillets. If Mr. Gobeille can purchase leather fillets cheaper than those of wood, we will gladly take off our hat to him, as the quotations of three of the leading pattern shop supply houses give the cost of leather fillets almost double those made of wood.

The plan suggested by Mr. Gobeille, that any three neighboring foundries had best join forces to produce cheaper patterns for each, is a decided innovation, but we fear that until such time as the campaign of the American Foundrymen's Association in the interest of foundry education shall have borne ripe and wholesome fruit, and the mutual benefits of such a coalition are no longer seen with envy, this plan will be honored more often in the breach than in the observance.

MAKING PATTERN MAKERS.

The discussion which followed the reading of Mr. Gobeille's paper at the Milwaukee convention of the American Foundrymen's Association, brought to light at least one method adopted in the making of pattern makers, by first subjecting the apprentices to a six month's dose of the foundry, and the repair pattern shop connected therewith, to test their fitness. We infer from this that once the ability to learn is shown that the period is stretched to eighteen months, thus giving the tyros a good idea of the requirements of their chosen life work. They are then transferred to the pattern shop and rated as pattern-makers. It would seem that an additional eighteen months or two years should be devoted entirely to pattern-making to round out the total of service, as eighteen months as described could not, except in rare cases, produce a finished mechanic. It is, however, not to be denied that the method pursued has many advantages over the usual custom of compelling young men to spend all their term of instruction in the pattern shop, giving them little if any foundry experience.

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COMMENT ON ARTICLES OF INTEREST TO PATTERN-MAKERS.

The Foundry. On page 185 of Vol. 22, the old but ever fresh subject of making Globe Core Boxes is taken up, and it is contended that the half cores made in two pieces, and pasted, give better results than any attempt to make them in one possibly could.

On page 223, same volume, the proportions for white metal alloys suitable for patterns are given. One of 80 parts tin to 20 of antimony seems to be a rather expensive mixture for other than high class standard patterns. A cheaper alloy of 80 parts lead, 10 parts tin, and 10 parts antimony is recommended, though it would appear that this mixture is liable to excessive contraction due to the presence of so large a proportion of lead. This article is credited to *The Metal Industry*.

Gerald Flannigan's article quoted from the *American Mechanic*, on page 278, was published in the *American Machinist* many moons ago, and is a first-class argument against altering old patterns that have outlived their usefulness.

Volume 23, page 4, has a "pattern proposition," with description and sketches of a patent granted recently for a form of skim gate or feeder that to our positive knowledge has been in use for a period covering many years. If the patentee was the first to apply for letters patent on this method of gating patterns, he is to be congratulated upon his nerve and luck.

American Machinist. A universal shrinkage "Tram" to be used by pattern-makers is described in the issue of June 4th. This is decidedly novel in design in that it can be instantly adjusted for any metal contraction without the aid of shrink rules, one point remaining fixed, and the other sliding in a groove the upper edge of which is angled enough to allow shrinkage, after gib attached to moving point has been set, and it is brought to bear on the upper side and locked. This tool is worthy of a place in every pattern-makers kit, and should be included in every pattern shop equipment.

In the issue of June 18th, a crude method of making screw propeller blades is shown, stating how lay-out lines for outside pitch only can be scribed on a block of wood, leaving the rest of

the blade to be carved by rule of thumb; when lines could as well be laid out running to the hub, that would reduce the time consumed in making considerably.

A Press for Making Pattern Symbols, as used by the Lodge & Shipley Co., of Cincinnati, is shown in the issue of June 25th, and it is several strides in advance of fastening lead letters on patterns with either nails or shellac, or both. A thin annealed brass plate is stamped with the required symbol through the medium of steel discs that have letters and figures carved on their perimeter, seven being assembled on one shaft, thus forming three letters and four figure combination symbol plates to be fastened on patterns with either nails or screws. It is claimed that symbols made in this way show up very well on castings.

The same Journal for July 16th, contains a two column article entitled "Modern Pattern Shop Practice" that is so utterly elementary in subject matter and treatment thereof, that comment would seem to be superfluous.

Pattern making and molding for a special valve casting "with accompanying sketches" shown on page 1027 of the same issue, would seem to prove that the designer thereof had very little knowledge of the molder's art, and even less regard for foundry and pattern shop costs(something that about ninety-nine designers out of a hundred could study with considerable profit to themselves and the foundries and pattern shops affected.)

The subject of Pattern Shelving is treated in a masterly manner on page 1057, and the sketches given present an ideal method for arranging shelves so as to be "get-at-able." With suitable modifications the system can be adapted for storing away any class of patterns.

On page 1141, a new band-sawing machine is described that has some novel features, chief of which is that the wheels are formed by two dished sheet steel discs placed together and riveted through. Vulcanized tires are upon them. The lower wheel is shielded in front by hinged doors, and the table tilts 45 degrees one way, and 15 the other. The machine, as a whole, appears to be a strictly up-to-date tool.

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FOUNDRY ACCOUNTING.

Edited by Kenneth Falconer, 34 Staynor Ave., Westmount, Montreal P. Q.

Discussions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Falconer.

GREETING.

There is an Eastern proverb which says, "That which is read is as one. That which is said about that which is read is as one thousand." This we take to mean that in free discussion will often be found more of value than is contained in the original article. It is along these lines that we hope this new Department of the Journal will prove of value to American Foundrymen. As it is the intention of the Association to establish a Section for Foundry Accountants this year, if possible, we take this opportunity to urge those interested to study these columns carefully, write their views to the editor in charge of the department, and get into touch with him. If those who find in their own case special value in certain methods of accounting work, or special difficulties to be overcome, would describe the one or state the other, it might in the first case be of benefit to others, and in the latter, to themselves.

We will at all times take great pleasure in taking up inquiries relating to Foundry Accounting, and would especially be glad to do everything possible toward furthering the formation of the Section for Foundry Accountants. The Secretary of the American Foundrymen's Association will also be glad to write to those interested in the new departure, and requests that they send their address to him.

FOUNDRY ACCOUNTING.

Technical Accounting.

Modern industrial conditions are such that any suggested change in methods of management in a productive or industrial organization is studied in exactly the same light as any proposed change in the mechanical processes of manufacture, or of work; viz., by its probable results as they may affect the relation between costs and values, or tend toward profit or loss. The one, as the other, must give reasonable promise of a dollar and cent value in

the shape of increased quantity, bettered quality, or lessened cost of output.

That the technical accounting of a shop or factory should be judged in this light and put to this test is both reasonable and practicable. While it is undoubtedly a branch of book-keeping, it is also very much more, and instead of being merely a method of collecting data and records more or less valuable, an efficient shop system is in itself an active influence towards economical production. In this light its work is executive, and it is an important detail of management.

The primary value of a cost system is admittedly in direct proportion as it makes for reduced costs of product. There are, however, other ways in which it may be of equal, or even greater, value to the management. Leaving aside all question as to whether a cost system should take cognizance of selling, as well as of manufacturing, expenses, and admitting that any influence towards the lessening of any detail of shop expenses necessarily results in a proportionate lessening of the cost of manufacture, there are other ways in which a properly devised and intelligently operated system of technical accounting may be an active force towards ultimate success.

Fouudry Accounting.

It is only of recent years that the fundamental importance of specialized technical accounting has been generally recognized,and in our own line of industry, Foundry Acconnting, as distinct from ordinary methods of book-keeping applied to the foundry business, is yet frequently regarded as impracticable on account of existing difficulties, or valueless because of peculiar conditions.

In a letter written less than two years ago from one of the largest centres of the trade, the assertion was made that "few foundrymen know their costs." About the same date a man ranking high in this branch of industry, said, "Fifty per cent. of foundrymen do not care anything about a cost system." In neither case was the statement a chance remark, but in each it was the deliberate expression of opinion by men both of whom rank high amongst American foundrymen, and both of whom saw and admitted the practical dollar and cent value to any foundry, of a thorough and efficient system of accounting.

That to a large extent this indifference is being replaced by a growing interest in the question, and an increasing recognition of

its importance is undeniable. Not the least evidence of this is perhaps the decision to create a department in this Journal devoted to the question of Foundry Accounting. Having been honored by an invitation to take charge of the space allotted to the subject, we do so, hoping that there will be found in these columns each month something not alone of interest, but of practical usefulness. If this new department of the *Journal* increases the interest in foundry accounting; if it induces foundrymen to examine whether their present methods are altogether satisfactory and reliable; if it makes them inquire whether they possess full detailed knowledge of the thousand and one indirect expenses of producing castings; if it causes them to inquire whether they know every possible channel of loss, and can instantly see any increase or decrease in each, and trace the connection between cause and effect; if it makes them consider if that which in other branches of industry is so generally admitted to be essential to success, could not be applied, with advantage, to the foundry, then the industry in which we are all interested will benefit. In the foundry business, as in any other, legitimate competition based on accurate knowledge is all right:—unintelligent competition without such knowledge is ruinous to all concerned.

Foundry Cost Systems.

That the conditions existing in the foundry render the introduction of a complete cost system somewhat more difficult than in other branches of manufacturing is possibly true; they should not, however, render it more difficult to operate a proper system when such is once installed. The very conditions which go to make the peculiar difficulties of Cost Accounting in the foundry also go to make it of very special value therein. Cost of product is invariably composed of three elements, labor, material, and indirect expenses, and it is universally admitted that in the last element will be found the greatest opportunity for cost reduction. The price of labor is largely governed by local conditious, and existing circumstances—of material by ruling market prices;—whereas the amount of manufacturing expenses is very largely a question of efficient or inefficient management. Accepting these statements, it follows that opportunity for cost reduction is in direct ratio to the proportion indirect expenses bear to the cost of product. Assuming a foundry and a factory making machine tools, the labor and material chargeable directly to individual costs will represent a larger proportion of the total cost in the latter case than in the former; the in-

direct manufacturing expenses of the foundryman will be larger in proportion to the cost of his output than those of the machine tool builder. The logical inference is that, efficiency being equal, a cost system in the foundry offers more opportunity for cost reduction than in the machine shop.

Estimating.

In any productive or constructive organization, both the amount of business secured and the profits realized will largely depend upon the work of the estimating department. In their turn those concerned with the making up of estimates must depend upon the accuracy of the information supplied by the cost department. In many cases a large proportion of the business done by a foundry is secured at prices based on estimates of the probable cost and records of past work, more or less similar in nature. Detailed records of cost are of value for this purpose in direct proportion to the amount of business secured on such basis. If selling prices were in all cases left open until completion of the work, and could then be based upon the actual cost; if orders could in every instance be secured without quoting prices, then Cost Accounting would lose one of the strongest arguments in its favor. In its relation to estimating, the word "costs" must be taken in its broadest sense. Accurate and reliable records of the cost of operating and of maintenance of each department or branch of the business as well as of costs of productoin are essential to the close estimating which is required by modern conditions. Not only must such expenses be accurately known, but they must be known to the utmost detail. Where close figuring is required as it undoubtedly is under prevailing conditions, this information is valuable as showing where an attempt to lessen costs may be made with the most reasonable expectation of success.

Indirect Expenses.

In its relation to indirect manufacturing expenses will very largely be found the usefulness of Cost Accounting. In many manufacturing enterprises the aggregate of such expenses will more than equal the wage cost of product, and the foundry is possibly no exception to the rule. Nowhere is the total of this element of cost composed of a greater variety of expenses than in the foundry, and in direct proportion as these are known in detail—as they are ana-

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lyzed and compared, may they be kept to the lowest percentage possible.

Many of the thousand and one indirect expenses of the foundry are peculiar to that business alone. Such losses as waste in handling scrap and other materials, the loss by bad castings, whether resulting from poor workmanship, defective patterns, or any other cause, must be accurately recorded in such manner as to permit of frequent comparison, if they are to be kept down to a legitimate figure. The necessity of this is increased when the foundry is operated as a department of a manufacturing business instead of being an independent concern. In such cases defects in castings may be detected only after more or less machining, in which cases there is an added loss. The point to be considered. however is not the difficulty of keeping track of losses occuring through these various channels, but the necessity of so doing. It has become almost a truism to say that the first step towards stopping a leak is to find it:—it is equally true the first essential towards preventing an increase in any item, no matter how apparently trivial, of indirect expenses is to have constant, periodical and prompt records of the amount of each. This is a proper cost system in the foundry should furnish regularly as part of the current work, not as a record of the more or less distant past. In this direction the value of Cost Accounting is in direct proportion not only to the accuracy of its results or the detail to which they are recorded, but equally to the promptness which the information is supplied, and the opportunity it affords for periodical comparisons with data of related interest. In the foundry even more than in the factory must manufacturing expenses be capable of close analysis and comparison from month to month, and "per 100 lbs of output" should be the final test to which all the items forming it are ultimately brought. Success or failure will depend very largely on the amount of output in a given period of time, and the channels through which the cost per 100 lbs. may be unduly increased are so varied in their nature, and many of them so apparently trivial, that close watch is essential to economical production.

The proper distribution of manufacturing expenses on the cost of individual articles procuced is one of the most severe tests of any cost system, and here again the special conditions obtaining in a foundry necessitate special treatment. In most lines of manufacture either the wage cost of individual articles or the number of

hours expended on their manufacture, is the factor which determines the amount of indirect expenses to be charged to each individual cost. A more correct basis of distribution in the foundry is to calculate such expenses as a ratio on the output; this, because the indirect expenses will usually vary in direct proportion as the weight of the output being only very slightly changed by other conditions. Any differences in the nature of the output, whether consisting of light or heavy, complicated or plain castings, will be found practically to affect only the direct wages and to make no appreciable difference in the indirect expenses of the concern. Too much care can not be taken in determining the rate to be adopted to provide for manufacturing expenses. If the output is charged with an amount greatly in excess, or much less than, that required to cover these expenses, the result will be unreliable records of profits or of losses on sales, and dangerously misleading records of costs on which quotations for future sales will necessarily be very largely based.

Cause and Effect.

In the foundry as in the machine shop constant efforts to secure the maximum of output in the minimum of time, to effect economies and to prevent wastes, are essential to keeping in the front rank. In this connection it is well to remember that any failure to realize a possible profit or to effect a possible saving is as truly a loss as the sale of goods to a hopelessly bad account or the destruction of material by fire.

Additions to plant and alterations to equipment, changes in mechanical processes, and methods of work, are constantly being made with these ends in view. That they must in the first instance be largely based on judgement and experiment is true, but after they have been fairly tried, it should not be a question of judgment or opinion, but of proven records, as to their results. In clearly indicating the relation between cause and effect—between circumstances and results—lies a field of legitimate accounting work in which may be found a very practical value of an efficient shop system. The value of any means of increasing output, checking losses, or lessening costs, will be very greatly increased if their results can be promptly and accurately known. A marked increase of output is sometimes gained at the cost of an unseen increase of indirect manufacturing expenses, which may almost or altogether offset the advantage gained. A very evident economy is often ef-

fected at the cost of an undetected loss, greater perhaps than the more noticeable gain. A shop accounting system in a machine shop or foundry which clearly exhibits as it may and should, the true effect of changes of methods, or additions to equipment, which indicates to how great a degree, if any, such changes are of benefit or such additions of advantage; which, in other words, stamps each with its actual, not its apparent, value, may ultimately go a long way towards turning the scale from failure to success.

SHOP ORDERS.

The Foundry, May. Mr. R. W. McDowell describes his method of tracing the so-called shop orders for work to be done for the use of the establishment itself. It is highly necessary to have an accurate system of costs for these shop orders, as they are a fruitful source of leaks; the men, as well as the supervision, not taking kindly to the "red tape" involved. It is of course essential that no work whatever be done without an order, otherwise the system fails. An example is given in an order for 100 rammers. Five carbon copies are made, one each going to the foundry, machine shop, blacksmith shop, and pattern shop. The blacksmith shop not having to do any work under this order, its copy is destroyed. The first copy goes to the pattern shop, where the work is commenced. A card is made out, the time of commencing and completing the pattern being filled out by the foreman, the order being turned in at the completion of the job. The foreman, moreover, is careful not to receive an order before he can put a man to work on it. There can therefore be no discrepancy as to time, and the foreman writes his material directly on the order received. The pattern being ready, the foundry order is given out. A production sheet for each man is made out daily, no time card being necessary. The machine shop gets the order as soon as the castings are ready. The orders finally all being in, a permanent record is made on a special card. These cards are 4 x 6 and are filed according to order numbers. A labor distribution card is made once a month. Orders representing regular equipment, and not repairs merely, are entered in the invoice book which answers as a perpetual equipment record. The foreman keeps the office posted on the equip-

ment which is worn out and discarded, so that everything may be correctly recorded, a stock-taking every six months checking this thoroughly.

ORDER SYSTEM FOR FOUNDRIES.

The Foundry, May. When foundries have a large output and make a specialty of miscellaneous jobbing, an order system, says Mr. J. Byron Hay, is very essential. The order is properly numbered and filled out to show shipping directions, date, and the necessary items, and a column left to fill in the various amounts sent out. The order is written for issue to the shop, a copy is written for the shipper, and a carbon copy for the molding shop. The stub carbon copy remaining is for the office record. The shipper's copy with the molding shop copy is sent to the pattern store room, where all patterns are tagged, before being turned over to the foundry. Proper filing cases are placed in the pattern as well as shipping room, while in the molding room the ordinary filing cases are used. As the castings are weighed, they are checked up on the orders, and finally the shipper's orders get back to the office for filing, and the molding room copies are destroyed. The idea is to have a record at all times of just what patterns have been tagged, and the date of such tagging. Then by calling for any special item wanted, a report can be made in a very short time regarding the actual condition of the order, the records simply being borrowed from the shop they are in, to be returned when through with. Next, the original records are at all times at hand and very little transferring is done, and thus errors avoided. Finally, before filing away permanently, the shipper's orders are gone over, and the face discloses if completely filled.

FOUNDRY PATENTS.

Edited by S. H. STUPAKOFF, 545 Turret St. Pittsburg, Pa.

Discussions, comment and criticism are invited. Kindly direct all correspondence for this department to Mr. Stupakoff.

ONWARD!

A few words on the title page of this journal explain its whole grand object. It is to be a "Compendium of contemporary foundry thought." This simple statement is, however, of such a breadth that our subscribers, and especially foundrymen, will expect to find within its pages a complete compilation of everything new and everything worth knowing in their particular branch of the iron industry. They will turn to it for information, as they turn to their Encyclopedia for general reference, and they will trust to its reliability as they know it to be authoritative.

Guided and assisted by many earnest co-workers, all successful and well-known members of the American Foundry Industry, specialists and authorities in their several branches, the JOURNAL branches out in many directions, it steadily aims to raise Founding to its proper place among the arts and sciences, it is eagerly read, carefully studied, everywhere quoted, and now has reached a high level of reputation. By continuing along the same lines it cannot fail to reach a point when it will completely cover the entire field of foundry knowledge.

To be complete in every respect, the JOURNAL OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION must be up-to-date in everything pertaining directly and indirectly to the foundry. It must not be necessary to hunt up information in other records, after its contents have been regularly and fully perused and noted. To aid in this work, there will appear from now on in these columns a digest of new inventions of interest to foundrymen, which will keep them posted on what passes through the Patent office. These abstracts will be accompanied by brief comments free from bias or prejudice. Good points as well as bad ones will be ventilated in the light they appear to the editor of this department.

It will necessarily be conceded from the outset that the opinion of a single observor, who does not pretend to be infallible and who can devote but a portion of his time to this work, may not always

be the correct or conclusive one. For the same reason it may occur that important features and facts may not be sufficiently illuminated, others seeing them at first glance. Whenever this is the case, the readers of these columns are cordially invited and requested to freely communicate their respective views to the Department Editor, who will be glad to make the necessary corrections in some subsequent issue of the JOURNAL. Thus will questionable points in patents relating to foundry practice be thoroughly ventilated.

It is to be hoped that by the free interchange of opinions every one affected will be the gainer, the JOURNAL will increase in value, and the earnest efforts of the American Foundrymen's Association may find even more acknowledgement than that which it so justly deserves and enjoys at the present time.

RECENT PATENTS OF INTEREST TO FOUNDRYMEN

No. 736,350. *Brake Shoe* with an outwardly extending steel reinforcing web. Patent granted Aug. 18, to Thos. M. Bell, of Philadelphia, Pa. This reinforcing web indicating the safty limit to which the shoe may be worn.

No. 736,419. *Riser* of refractory material used in connection with a mold for casting rollers or similar article. Patent granted Aug. 18, to Robt. A. Mick, of Paterson, N. J. It is covered by six combination claims; the fifth one refers to the riser as arranged concentrically, which is evidently an error, unless it is to be used in connection with the casting of cylindrical shapes. It appears that there is not much danger of infringements as the advantage offered by this method of making a mold is rather vague. The refractory riser tubes are unquestionably worthless after a single application, as they must be destroyed to remove the iron core.

No. 736,678. *Mold for Chain Links*. Patent granted August 18, to James Bone and Morris Reid, of Glasgow, Scotland. The description implies that the device is a chill, and that it is especially intended for railway car links; it is therefore to be used for making steel castings. It consists of several jointed blocks which when properly assembled, form a complete mold, consisting of drag, cope and core. The entire mold as shown is arranged in a special framework on legs, and the whole has the appearance of a machine, though it is in fact a separate chill, consisting of several parts, suita-

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bly jointed at the partings. The cope portions are provided with the necessary gates and with recesses, fitting in upright guides of the lower part, and they are raised or lowered by means of a counterweighted chain. The drawings and claims show nothing as to how the detrimental effects of the contraction of the castings are taken care of.

No. 736,841. *Molding Machine.* Patent granted August, 18 to E. A. Goepper, of Louisville, Ky. It consists in its essential parts of a stationary table to which the patterns are secured, and a removable frame with lifting pins, which raise the flask frame from the patterns after the mold has been rammed by hand. The lifting frame is guided at the top and bottom by pins, and its vertical movement is accomplished by the turning of a lever handle which operates a crank by means of a connecting arm. Though there is nothing staggering in this arrangement, as the application of the same principle is to be found in old and well-known designs, the patent is covered by eleven worthless combination claims.

No. 737854. *Pattern-plate.* A pattern-plate with one half of a hollow pattern for molding cored articles, was granted to John G. Morrison, September 1st. The specification contains an elaborate description of the old methods of molding hollow articles by using dry sand and green sand cores. It compares these in a not less elaborate manner with the method as covered by the patent in question. The principal feature of this patent is a hollow pattern, one half of which is secured to, or forms part of, a pattern plate (which looks very familiar), and the other half of which is left loose. Both are used in connection with a specially prepared match board, and the pattern-plate is joined thereto by open hinges. The pattern is used as a core box, the core is rammed up in halves, a core arbor is used when necessary, and the halves are joined as one would close a book. By proper manipulation, and turning the flask the required number of times, the mold can be produced with the core in place, without handling the latter. The same thing could of course be accomplished without the pattern-plate, by the mere use of half patterns and the necessary match board. This has been done before, and undoubtedly will be done hereafter, unless a continuous run of the same pattern justifies costly experimenting with an innovation (?) of problematic superiority.

CORRESPONDENCE.

At the Milwaukee Convention we honored ourselves by electing to Honorary Membership Prof. Thomas Turner, of the University, Birmingham, England, and Prof. Dr. A. Ledebur, of the Royal Mining School, Freiberg, Germany. We have received the following letters from the above named gentlemen, and feel certain that our action has done much to promote a feeling of friendship among the foundrymen of the three nations interested.

THE UNIVERSITY, BIRMINGHAM, July 1st, 1903.

Dr. Richard Moldenke, Sect'y,
American Foundrymen's Association,
Dear Sir:—

In was with much pleasure that I received your letter of June 20th, informing me that I have been elected an Honorary Member of your Association. I can assure you that the honor thus conferred upon me is much appreciated, and I shall follow the proceedings of your Association with even more interest than heretofore.

With best wishes for the success of its work, and for the extension of friendly intercourse between the two Nations, I am, dear sir,

Yours very truly,
(Signed) THOMAS TURNER.

Freiberg in Sachsen, den 5. Juli, 1903.

Hochgeehrter Herr Dr. Moldenke,

Sie haben mir durch Ihre freundliche Benachrichtigung vom 20. v. M. eine große Freude bereitet, für welche ich Ihnen herzlich danke, Sie bittend, auch der **American Foundrymen's Association** meinen verbindlichsten Dank für die hohe Auszeichnung übermitteln zu wollen, welche mir durch die Ernennung zum Ehrenmitgliede dieser Gesellschaft zu theil geworden ist. Ich werde stets, so lange die Vorsehung mir das Leben läßt, mit lebhaftem Antheil den Verhandlungen der Gesellschaft folgen

und nach Kräften bemüht sein, auch meinerseits ein Scherflein zur Förderung des Gießereifaches beizutragen.

In vorzüglicher Hochachtung

Ihr ergebenster

(gez.) A. Ledebur.

For the benefit of those of our members who may not be acquainted with the German language, the translation of the above communication is appended herewith:

FREIBERG, SAXONY, July 5th, 1903.

Dear Dr. Moldenke:

Your kind communication of the 20th Ult., has given me much pleasure, for which my best thanks. Kindly also transmit to the American Foundrymen's Association my sincere gratitude for the distinction conferred upon me with the Honorary Membership in that body.

As long as an All-Wise Providence grants me life, I will follow your proceedings with the greatest interest, and will endeavor to add my mite toward the advancement of the foundry industry.

With kindest regards, I remain,

Yours very sincerely,

(Signed) A. LEDEBUR.

THE FOUNDRY FOREMAN.

Edited by JAS. A. MURPHY, Secretary of the Foremen's Section of the Association. Address all correspondence direct to him, to 114 West 20th Street, Erie, Penna.

GREETING.

This department of our Journal is specially devoted to the interests and advancement of Foundry Foremen. Here you are welcome to ask questions concerning foundry practice. If you have trouble with any particular job, you will find several readers of this department able to help you.

This is a good place to explain some of the so-called mysteries; a place to tell something which will do a brother foreman some good. So do not be afraid that your idea is an old one. It will surely be new to some one.

There are a lot of things to write about in our business, so set about doing a little on your own behalf. Never mind if you cannot write a business college hand, or string over a hundred words in a sentence. It is the idea we are after and not the style of composition. Put it down on paper and send it to us, leaving to the Editors the task of making it a credit to writer when it appears in print.

LOCAL FOUNDRY FOREMEN'S ASSOCIATIONS.

Aside from the National Association of Foundry Foremen, the first local body to be organized was that of Erie, Pa. It dates from April of this year. The objects of this association are outlined in the constitution as follows:

"It shall be the object of this society to promote the advancement of the foundry interests in the City of Erie, Pa. To endeavor to have more uniform systems of management; customs and discipline prevail among all foundries; to encourage thought on scientific and mechanical matters, and the mechanical and scientific advancement of the art of molding and founding in their several branches; to collect for the use of the society all proper information relative to the art of molding, the operation of foundries, their management or anything connected with the foundry business; to strive to have a more just and equitable system of apprenticeship prevail in all shops in which we are or may be connected to the end

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that we may lend our best efforts towards the making of better and more intelligent molders and coremakers, and to as soon as possible establish a night school for the technical instruction of foundry apprentices in the city."

This Association has in the short time of its existence proved itself an unqualified success, in fact a necessary adjunct to proper foundry management in the city.

The inspiration from Erie is spreading out in many different directions, and the latest addition to the local Foundry Foremen's Associations is that of Milwaukee, where a particularly healthy branch is doing business with a vim and vigor characteristic of that bustling locality.

The officers of the Erie Association are: President, Wm. F. Grunau; Vice President, Chas. Urich; Secretary, Harry Kies; Treasurer, Jas. A. Murphy.

The officers of the Milwaukee Association are: President, Sol. Shaw; Vice President, David McLain; Secretary, Thomas Glasscock; Treasurer, Peter Hott.

There are other local associations in process of formation in the large foundry centres, and the precedent established by Milwaukee and Erie will soon be followed generally throughout the country.

To show the spirit that is behind the foundry foremen's movement, we quote a few extracts from a circular letter recently sent to Foundry Foremen throughout the country, by the Secretary of the "Affiliated Foundry Foremen":

"We feel that the objects of this Association ought to be called to your attention, for with the advance of thought, scientific and practical, among the engineering professions, we find ourselves the only large body of men having the practical control of shop affairs without a strong and compact organization through which we may assert ourselves.

"It is within the power of those having charge of foundries to improve themselves by a liberal interchange of ideas, and by acting as a unit on matters affecting them in any part of the trade. To be mutually remunerative to the fullest extent the Association should have the hearty co-operation of every foundry foreman.

"However much such things are to be desired, it is a well-known fact that many of our foundry managers are indifferent to the progress which surrounds them on all sides.

"No foreman should feel that his employer may, perhaps, have a prejudice against our Association, as we point with pride to the fact that we have received the endorsement and support of the American Foundrymen's Association, we forming the Foundry Foremen's Section of that powerful and influential organization.

"The foremen of large cities would find it of particular advantage to have a strong conservative organization. The many benefits that accrue from such Associations when conservatively managed are too well established to be dwelt upon to any length here. To such local branches of our Association we are ready at any time to give all the help in our power to steer them in a methodical course for the mutual advantage of its members.

"We trust that this appeal will not be lost upon you, but that as a practical man, believing in the advancement of our profession, you will give us your aid in the cause of education, mutual help and the practical advancement of foundry management."

To the above may be added and urged that it is the hope of the American Foundrymen's Association, that all of the members of the National and Local Associations of Foundry Foremen also join the great Association of Foundrymen. Special inducements are held out for this purpose, and indeed the future relations between the parent bodies of foundrymen and foundry foremen will in a great measure depend upon the mutual support accorded each other.

PROCEEDINGS OF THE ASSOCIATED FOUNDRY FOREMEN.

One of the last things from the pen of the late Henry Hansen, then secretary of the Associated Foundry Foremen, and published in the journal he edited, *The Foundry*, was an account of the convention of that Association. We cannot do better than to give it in full herewith.

The Associated Foundry Foremen held an executive session in the club room of the Hotel Pfister during the evening of June 8th, at which the following questions came up for discussion:

Is it an advantage to a foundry to place the cupola and metallurgical operations under the control of some one other than the foundry foreman?

Do our larger foundries employ a sufficient number of foremen?

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Do you find analyses, as furnished by blast furnaces, trustworthy?

In your opinion, are there any special advantages in the continuous operation of a foundry? Is the output of molders working overtime equal to that produced during regular working hours?

What can be done to insure harmonious relations between foundry and pattern departments? Are stated meetings for heads of departments desirable?

Do you know a simple system of shop orders for foundry use, by which delays are avoided in pattern, flask, molding and core departments, and through which the progress made upon a job is readily ascertained at any time?

How can the foundry foremen best serve the interests of the industry through united effort?

The general opinion appeared to be that where a competent metallurgist is employed he should relieve the foundry foreman of responsibility in connection with mixtures and leave the latter free to devote his full time to molding. It was conceded by all that the modern foundry needs the aid of the analyst to secure the best results. One of the metallurgists present suggested that where the size of the plant warranted such a course, excellent results would follow the placing of all metallurgical operations under the control of the superintendent, confining the sphere of the foreman to actual molding operations and having the chemist occupy a middle ground. It was pointed out by the same speaker that it is absolutely necessary that the chemist must learn to supply the needs of the foundry and that he should be trained in a responsible institution. One of the foremen took the position that at the present day it is simply a question whether the foreman will fit himself to take full responsibility. In his opinion there could be no division of the latter and if necessary the foreman should be given more assistance, including that of a chemist.

Relating to the employment of a sufficient number of foremen in the larger shops it was pointed out that the responsibility for proper supervision rested with the superintendent or general foreman, although the latter might at times dislike to ask for additonal assistance from the company. Modern shops are realizing that they must have a sufficient number of foremen to look after shop details.

The majority of those present stated that furnace analyses are

fairly reliable, especially where it is known that these are rechecked occasionally. One of the chemists present took the opportunity to call attention to the fact that while the majority of furnaces make it a practice to analyze each cast for silicon and sulphur, it is the average analysis for the period of a day which founders generally receive.

Discussion as to the continuous operation of foundries developed considerable difference of opinion. On the larger class of castings the chief objection appeared to be that with several different sets of men working on the same job there would be difficulty in placing the responsibility for loss upon any in case of accident. It was recognized that for standard work, and especially for light castings, there were certain advantages in operating a plant continuously. On general principles the doubling up of molders on the same job and the working of overtime was not deemed good practice where this could possibly be avoided, as the output secured in both quality and quantity was superior when obtained in regular day-light working hours, with every man taking increased pride in work which was his own individually.

Another question brought up at the meeting read: "Is it justice to a firm for molders not in a heat to stop work when casting begins?" The statements made showed that considerable difference exists with localities and that in many parts of the country it is the custom for molders to put in a full day at molding when they have no work of their own to pour off and are not called upon to assist others. In other sections it is the practice for molders to consider that their day's work of molding ends as soon as the blast goes on. One foreman remarked that the easiest way to overcome questions of this kind was to grant increased pay to rapid workmen mentioning the fact that while the rate of pay in the shop with which he was connected was $3.25 for 9 hours, the average daily earnings of all molders were $4.33.

The setting of a day's work also received some attention from the foremen. The practice of one shop where the molders settle this matter for themselves by agreeing to mold certain castings within a specified time, and receiving full pay for all time they manage to save was commented upon.

The election of officers of the Associated Foundry Foremen resulted in the selection of Charles H. Thomas, Newark, N. J., as president; Edward Gilmour, Peoria, Ill., vice-president; James A. Murphy, Erie, Pa., secretary and treasurer.

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PERSONALS.

Mr. William Cureton has resigned his position as Superintendent of the Buffalo Foundry. The employees in the shop presented him with a magnificent gold watch as a mark of their respect and esteem.

Mr. Walter Wainwright has sold his interest in the Fostoria Foundry, and has taken charge of the Glens Falls Foundry, Glens Falls, O.

Mr. Andrew Macduff, for the past sixteen years in charge of the Stillwell-Bierce & Smith-Vailie Co., has resigned his position with that Company.

Mr. David Reid, who read the interesting paper on "increasing foundry production" at the Boston Convention of the American Foundrymen's Association, has taken charge of the foundry of the Rarig Engineering Co., Columbus, Ohio.

Mr. William Hanson, for many years in charge of the foundry of the Pennsylvania Iron Works, Philadelphia, has accepted a similar position with the Canada Foundry Co., Toronto, Ont.

Mr. Stanton R. Costley has taken the superintendence of the new plant of the Construction Iron Co., at Monongahela, Pa.

PROCEEDINGS.

THE FOUNDRY ASSOCIATION ADVANCE.

The Iron Trade Review, June 11. We give below extracts from an editorial which should spur us on to still greater efforts. Such words written by an editor of broad-minded views and warmly interested in the advance of every branch of the great iron industry, are certainly encouraging. The friendship thus extended is returned in the heartiest manner, and we will strive to merit the praise bestowed by aiming to constantly raise the plane of the foundry industry. Mr. A. I. Findley, the editor of the *Iron Trade Review*, writes thus:

"The American Foundrymen's Association is to be congratulated upon its status as shown by the reports presented at the Milwaukee convention this week. The association has accomplished already far more that is of permanent value to the foundry trade than the most optimistic advocates of the association idea would have predicted two or three years ago, and its usefulness is far from reaching its limit. From being commonly reckoned as an organization, whose chief activities were connected with the anuual meeting, and these very largely of a social character, the Association has been making marked progress as a medium through which cast iron is being intelligently studied and the problems of melting and molding brought further on toward a solution. There have been times when those largely responsible for the reputation the American Foundrymen's Association has won as a working organization have had reason to feel that the foundrymen of the country were little responsive to their efforts, and it is possible that the prominence given metallurgical questions that were over the heads of the average convention audience had something to do with the attitude of many.

While far from being what it should be, the financial exhibit at the Milwaukee convention is the best in the association's history, Its journal now goes to many foreign investigators in the field of cast iron and its members and subscribers number 317. In the past year a step has been taken that promises an enlargement of influence, in the organization of the metallurgical section and the separate section for foundry foremen—the former for the study of pig iron and cast iron, and particularly questions relating to chem-

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istry, heat treatment, testing and the making of mixtures, while the foremen's section will devote itself to foundry equipment and practice, the cupola and the molding floor. Wages and prices for product have never entered into the councils of the association; but the general question of the relation of employer and employe has been incidentally involved in some of its work, and very naturally in a review of such a year as that just ending President Walker touches on what in the minds of many is the uppermost feature. Similarly Mr. Carnegie in his inaugural address as president of the Iron and Steel Institute laid much stress on the reward of the workman and the best method of securing for him an equitable share in the profits of industry. President Walker's comments on this subject are eminently judicial and temperate and breathe a reasonable and optimistic spirit.

Whether gauged by the reports of the association's activities in the past year or by the excellent program of papers at Milwaukee, the convention of this week plainly represents high water mark for the American Foundrymen's Association, and there are good indications of a new high record for the year to come.

PROCEEDINGS OF THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The one hundred and twenty-ninth meeting was held on June 3rd. President Devlin in the chair. The Treasurer's balance was $1977.86, and all indebtedness paid. The following were elected to membership: The Bethlehem Steel Co., Bethlehem, Pa.; The Camden Foundry Co., Camden, N. J.; Bernstein Mfg. Co., Philadelphia; Standard Scale & Supply Co., Pittsburg, Pa.; The Bateman Mfg. Co., Grenloch, N. J.; and the American Glutrose Co., Camden, N. J.

While the meeting was scheduled to discuss the molder's situation, the fact that this had been done on the previous day by Philadelphia Foundrymen, allowed the dropping of this part of the programme. Prof. J. A. Holmes, chief of the Dept. of Mines and Metallurgy, then addressed the meeting in favor of making a thoroughly representative foundry exhibit at the St. Louis Exposition. He explained the matter at length, and suggested the appointment of a committee. President Devlin suggested that the American Foundrymen's Association as well as the National Foundrymen's

Association be asked to co-operate, and resolutions were adopted to that effect. Mr. Wesley Bartine then read a paper on the heating and ventilating of foundries. The Association then adjourned to September.

PROCEEDINGS OF THE NEW ENGLAND FOUNDRYMEN'S ASSOCIATION.

Mr. B. M. Shaw, vice president of the Association, presided at the meeting held on May the 13th, at Hotel Essex, Boston. The Manufacturers' Foundry Co., of Waterbury, Conn., was admitted to membership. A large attendance greeted the speaker of the evening, Mr. S. D.Leland, of the building committee of the United Shoe Machinery Co., of Boston, The paper gives the results of observations made in connection with the shops soon to be built at Beverly, Mass. His title was "Modern Shop Construction and Operation." In the course of the address it was pointed out that for heavy work but one type of building was available – the Monitor type. Lighter classes of work allowing a more varied construction. The Allis-Chalmers Co. plant was a model in its way, as it provided for a continuous passage of the material from the office to the shipping point. The saw-tooth arrangement of the roof of the General Electric Co., at Lynn, is a good example of shop lighting. There are, however, objections to having such long valleys running lengthwise of the building. Heat and ventilation by the hot blast indirect system seems to give best satisfaction, the air of the shops thus being changed every 20 to 30 minutes. Some direct heat is often added for the more exposed places, either by steam or hot water.

In the way of factory organization, the most approved method is to operate through a board composed of the officers of the company together with the heads of the departments. This board meeting daily or periodically at lunch, the policy of the company is outlined and carried out. Cost records are of the greatest importance, few shops having this perfect. The National Cash Register Company has an excellent system, which they call the clearing house, and where all material passing through in the regular operation is checked, and extra parts, etc., are stored until required.

In power distribution we are facing the more and more extended use of the electric motor. The simplicity of the distribution

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thus carried out is astonishing, and in the case of the P. & L. E. R. R. repair shops at Pittsburg, every tool will have its individual motor. For the foundry we are now finding the molding machine developed in economical directions. Occasionally we see a distribution of work aimed at which insures the material a straight course as for instance where the foundry is on the top floor, and the castings pass downward to be shipped from the basement. Where large quantities of work of the same kind is the output, foundries are beginning to put in conveyors to handle the molds and also arrange to have the work poured while in transit. The laboratory is now an essential feature of an up-to-date foundry.

Mr. S. B. Patterson then read a paper on "Quality of Pig Iron for Foundry Use," as shown by fracture and analysis, and the meeting adjourned.

The July meeting of the Association was held at Point Shirley Club, Winthrop, Mass., on the 8th. President Carpenter in the chair. During the short business session there was arranged to cooperate with the Boston Metal Trades Association, and the New England Iron League, organizations interested in the establishment and maintenance of a labor bureau. Messrs. John Magee and Fred F. Stockwell were appointed with full powers to represent the Association.

PROCEEDINGS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS.

Committee on Cast Iron.

The Delaware Water Gap meeting of this association brought with it a special session on cast iron, as well as a meeting of the committee on pig iron. Mr. Walter Wood submitted his report showing the progress made, and announced the chairmen of the various sub-committees then already at work. Special reports were sent in by the chairmen of three committees; on pig iron, general castings, and testing cast iron. Regarding the work on testing cast iron, Mr. Henry Souther had taken this up with the various members of the committee, and the consensus of opinion seemed to point to the transverse test as the one most likely to adopt, then that a so-called "arbitration bar" be selected, which could serve as a medium of comparison in disputes. This could be made

in such a way that all outside influences liable to hurt the various bars in use at present would be removed, and as this bar would only be called for in special and important cases, some time and expense could be put on it. Further developments were looked for along these lines in the near future.

Mr. West reported for the general casting question as follows:

"There are several points which require careful consideration before any action is taken to establish a standard. First: What is the character of work that should be considered as general castings? Second: What special character of specifications should govern each separate class of general castings. Third: Whether the best test bar cannot be made the fundmental guide for obtaining the desired physical qualities of many classes of general castings.

"In commenting upon the first, I would suggest the following gray and chilled iron specialties, classified in the order shown. 1. Stoves and household heating furnaces. 2. Hollow ware and bath tubs. 3. Radiators. 4. Small pipe fittings and valves. 5. Pulleys and fly-wheels. 6. Dynamos and electrical work. 7. Hydraulic cylinders. 8. Pneumatic cylinders. 9. Freezing machinery. 10. Gas engines. 11. Steam Cylinders and pumps. 12. Ingot molds. 13. Annealing pots and pans and gas retorts. 14. Acid-proof castings. 15. Cast and cut gearing. 16. Punch, chear, stamping and crushing presses. 17. Lathes, planers, shapers, and drill presses. 18. Printing presses. 19. Wood working machinery. 20. Weaving machinery. 21. Sewing machines. 22. Agricultural machinery. 23. Fan and blowers. 24. Foundry molding machines. 25. Journal boxes and hangers. 26. Sidewalk grating and manholes. 27. Furnace and floor plate castings. 28. Grate bars and fire backs. 29. Column and architectural castings. 30. Air brake and railroad castings. 31. Brake shoes—chilled and gray. 32. Squeezer plates and rolls, chilled and gray. 33. Rolls, Chilled and Sand. 34. Miscellaneous rough and machined castings.

"In the above specialties are lines of gray and chilled iron castings which have taken many years' labor and experience to perfect to meet the demands of modern service. The qualities exacted are best known to the makers and users. I do not wish it thought that I believe all the specialties shown are possible of being standardized; however, it is felt that dealers and users would gladly welcome any standard tests that would enable them to judge fair-

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ly of the durability of the new casting which they were purchasing. With this view of the subject it would seem that efforts should be put forth to formulate standards for testing all the lines of castings mentioned, as far as this is practical.

"In discussing the second proposition we are called upon to suggest special methods to govern tests for various specialties cited. In standards for testing stoves, etc., or Nos. 1, 2 and 3, it would be well where they are of a nature that would test the ability of independent duplicate parts to withstand radical changes in temperature or expansion and contraction under impact tests, in connection with the use of proper size and form of test bars, to give the contraction and strength of the iron comprising the heat of castings being tested.

"No. 4 would be well tested by having some stated standard of form and size to undergo tests of actual practice.

"No. 5 could probably not be better standardized than by tests showing contraction and strength of the iron in connection with chemical analysis.

"No. 6 involves physical qualities which could be well displayed for the work intended by hardness tests and chemical analysis.

"Nos. 7, 8, 9 are best tested by hydraulic pressure and are a class of work where standardizing would call for very varied practices. The test bar and chemical analysis might assist for many cases, but the hydraulic test which would disclose the evils of shrinkage should stand paramount to all others.

"Nos. 10 and 11 could be standardized by testing the contraction, strength and hardness of the iron comprising their structure.

"Nos. 12, 13 and 14 are best standardized by chemical analysis.

"Nos. 15 to 34 will be best judged of by means of standard test bars and chemical analysis.

"The third proposition puts forth the use of test bars to standardize general castings. I fail to perceive how many general castings can be standardized without their use, and for this reason I advocate their adoption as shown. It must be evident that to formulate standards for testing many of the specialties shown, involves great amount of labor and much expense, in some cases, as an example, as much as did the standardizing of tests for car wheels. For this reason an early formulation of standards cannot be expected."

At the meeting of the Pig Iron Committee, all interested in

this subject were present, Mr. Edgar Cook, president of the Warwick Iron and Steel Co. in the chair. After much discussion the following resolution was adopted, as to sampling:—(motion of Mr. A. L. Colby.)

"In contracts in which pig iron is sold on chemical analysis, it is the opinion of this association that each carload, or its equivalent, be considered as a unit, and that in said carload each two tons of iron shall be represented by a pig, said pig to be selected at random, so as to fairly represent the carload of iron. Futhermore, that the drillings be taken so as to fairly represent the surface of each pig; and that the sample analyzed consists of an equal quantity of drillings from each pig; well mixed and ground before analysis."

Then followed a long debate on the method of grading pig iron by analysis, the idea being to bring this method within the reach of every foundryman, whether he was familiar with metallurgy or not. It was specially stated that the grading thus recommended is to be used in the absence of specifications made between buyer and seller in the ordinary way where the foundry has a metallurgist.

Standard Grades of Pig Iron.

Grade.	Per cent. Silicon.	Per cent. Sulphur.
No. 1 Foundry	2.75	.035
No. 2 Foundry	2.25	.045
No. 3 Foundry	1.75	.055
No. 4 Foundry	1.25	.065

The following resolution was adopted:

"In all contracts, in the absence of a definite understanding to the contrary, a variation of 10 per cent of silicon either way, and of 0.01 per cent of sulphur above the standard is allowed. A deficiency of over 10 per cent in the silicon up to 20 per cent and further increase in sulphur up to 0.01 percent over the above allowance subjects the shipment to a penalty of 1 per cent in the price for each element so affected.

A number of highly interesting papers were read at the meeting, abstracts of which will be found elsewhere. The titles are as follows:—

Machine-cast Sandless Pig Iron, by Mr. Edgar S. Cook,

The Physical Properties of Malleable Cast Iron as effected by the Process of Manufacture, by Dr. Richard Moldenke,

Cast Iron for Dynamo and Motor Frames, by H. E. Diller,

Consideration of the Reactions which make Cast Iron valuable, by H. E. Field,

The Importance of adopting Standard Sizes of Test Bars for determining the Strength of Cast Iron, by A. E. Outerbridge, Jr.

The demand for a specified Grade of Pig Iron, by W. G. Scott.

Much information was brought out and this will be taken into consideration by the committee on pig iron, a final report of which is soon to be issued.

INCIDENTS OF THE MILWAUKEE CONVENTION.

As observed by one of our editors.

Members and visitors crowded around the table with printed matter as if it were a lunch counter.

Mr. Gobeille was full of wit, and the "old boy.,,

The Doctor was in his glory.

Talking of labor conditions is like throwing a fire-brand among the assembly.

Mr. Thomas enjoys his meals.

The foremen may get a swelled head.

Gilmour dabbles in molding machines.

The A. F. A. is looking for investments.

Obermayer keeps on tickling.

Milwaukee gave us a cold reception, the few overcoats in the crowd did good service.

Sheriff's sale of badges realized 25c. apiece.

Turner brews mischief among the ladies.

Knight has located the Southern Anaconda.

Milwaukee has no reason to feel sore about her reputation.

Lindeman will throw up his foundry and take to poetry. He has already added a Pegasus to his horses.

White Rock reminds the cupola tender of his limestone.

Core makers are usually considered to be better judges of sour beer.

The Foremen have adopted the blue ribbon.

You'll get used to the chimes if you stay long enough at the Pfister.

The B. F. Co. should cut the tail off their tape-worm right behind the neck and produce the short end on some other occasion.

It takes a Bostonian to detect gramatical errors in programs.

Mr. Gobeille has gained reputation as an after dinner speaker.

PIG IRON.

This department has been established for the use of producers and distributers of pig iron. It is not intended to be an advertisement of their material, but to impart information to foundrymen who are often unable to locate the brands and compositions they want. Correspondence and the free use of this department is urged upon the furnaces and selling agents, who may thereby gain wider fields, and at the same time place the foundryman in position to select from a larger variety of irons than he could before. Communications should be sent direct to our "Journal," P. O. Box 432, New York City.

The Superior Charcoal Iron Co., of Grand Rapids, Mich., announce that they are prepared to ship the following:

"Pioneer," "Marquette," "Excelsior," "Champion," with silicon from nothing up to 2.90; phosphorus, 0.15 to 0.22; manganese, 0.30 to 0.70; sulphur, trace to 0.018. Their "Antrim," "Elk Rapids," "Michigan," with the same composition excepting that the highest silicon is 2.50. The "Peninsula" has the silicon up to 1.90; phosphorus, from 0.15 to 0.19; manganese, 0.25 to 0.40; sulphur from a trace to 0.015. "Crescent" has the composition the same except that the silicon runs up to 2.50.

Mr. H. R. Durkee, of Chicago, Ill., announces that he can deliver the following:

"Ashland," with silicon from 5.00 to 10.00 per cent. "Briar Hill," with silicon 1.00 to 1.25; sulphur, up to .05; Phosphorus, up to 0.15; and manganese from 0.65 to 1.00. "Low Moor," with silicon from 2.00 to 7.00; sulphur up to .05; and manganese from 0.60 to 1.00.

HOW TO DETERMINE THE QUALITY OF PIG IRON.

In a paper recently read before the New England Foundrymen's Association, Mr. S. B. Patterson discusses at length the effect of the various constituents of foundry pig iron, in order to give foundrymen an idea as to how to buy their iron by its composition. Silicon and carbon are commented on at length. Manganese, phosphorus, sulphur, and finally titanium follow in turn, and then blast furnace conditions are taken up with a view to showing foundrymen how deceptive fractures may be made if desired, also as they are in regular runs of material from the furnace. Mr. Patterson thinks that the small foundry uses too many kinds of iron, and if the manager would take time to study up the situation much ben-

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efit would folllow. Finally a plea is made for the furnaceman, asking more indulgence on account of the many difficulties besetting the production of pig iron.

SPECIFICATIONS FOR FOUNDRY PIG IRON.

The Iron and Machinery World. In the anniversary number for 1903, Mr. H. E. Field goes into the question of purchasing pig iron by analysis. In general it may be said that the furnaces are now perfectly willing to sell pig iron by analysis, provided that the conditions to be met are not impossible on their face. A founder whose wants are within the ordinary bounds stands a good chance to get them fulfilled. Certain brands have distinguishing characteristics, so that only the silicon and sulphur need be specified. The phosphorus and manganese may be either high, low or medium in each case, so that there may be selected from six varieties for the work on hand. Mr. Field now goes into proper methods of purchasing pig iron, lays particular stress upon getting security, under the specifications, for overrunning the sulphur, or underrunning the silicon, by carrying a fixed penalty in the contract. He further argues that if the blast furnaces cheapen their iron by the excessive use of mill cinder, and this has detrimental results for foundry work, the trouble should be rectified, if necessary, by prompt rejection. Finally, Mr. Field gives a series of specifications for pig irons suited to various classes of work, which cover the ground extremely well.

THE DEMAND FOR SPECIFIED GRADES OF PIG IRON

American Society for Testing Materials. Mr. W. G. Scott, of Racine, Wisc., voices the general demand for specified grades of pig iron for foundry use. Where the fracture method was used the size of the crystal practically regulated the grade number, regardless of the consequences. The effect of the rate of cooling, well known to the blast furnace manager and taken advantage of by him, often left the foundryman in a very difficult position. By buying on specified analysis, based upon proper sampling, a great deal of annoyance and loss is done away with, and hence foundrymen have gotten to demand some sort of scale by which iron is

graded on analysis, the fracture being ignored. This specification for foundry pig iron is now being thoroughly discussed and will shortly be decided upon by all interests involved.

ADVANTAGES OF MACHINE CAST PIG IRON.

Cassier's Magazine, June, gives an interesting article by A. L. Colby, the resumé of which, as sent out by the publishers, covers the story so well that it is given herewith.

"As to machine-cast pig iron for foundry use, the purchaser of such iron will receive 2240 pounds per ton of iron shipped; there can be no dispute about short weights, and that abomination, the "sand ton" of 2268 or 2256 pounds per ton is abolished. The amount of sand adhering to iron cast in sand varies greatly. When the iron is loaded directly from the casting bed and has only a short haul to the foundry, the sand on the pigs is excessive. If loaded from stock and hauled a considerable distance, more of the sand shakes off before the pigs reach the cupola platform; but, at best, that remaining is a detriment, and frequent cause for dispute in weight and an expense in melting.

"In melting machine-made iron the founder will find that he uses less limestone. and that, therefore, less slag is produced. This means less fuel to dissociate the carbonic acid gas in the flux and less fuel to melt the smaller amount of slag produced; also less loss of iron in the slag. The machine-cast iron also melts easier—an item which gives a further saving in fuel. The melted iron is cleaner, contains no dross, and that frequent cause for defective work, "dirty iron," is absent. Another advantage of machine-cast iron is that the pigs of the cast are more nearly alike in chemical composition than pigs of a cast of iron run from the furnace into sand; and, furthermore, there is a greater uniformity in the different parts of a machine-cast pig than in a sand-cast pig. This greater regularity of the different parts of a cast is due to the fact that the furnace is tapped into 20-ton ladles, and the iron is thus mixed before casting the pigs. These are more uniform in composition, because they solidify more rapidly in the iron molds of the casting machine, and hence there is much less time for the impurities to segregate toward the top and center of each pig."

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CAST IRON.

SUSSEX CAST IRON.

The Iron aud Coal Trades Review, May 8th, gives the paper read before the Iron and Steel Institute recently by Prof. Thomas Turner, who is an Honorary member of our Association. It is about a specimen of Cast Iron from Sussex which is not less than 200 years old. It came into the possession of Dr. Percy, and contains: Silicon, 0.617; Manganese, 0.774; Phosphorus, 0.561; Sulphur, 0.082; Graphite, 2.890; Combined Carbon, 0.317, which explains itself. The article goes on to say, "It is well known that the Sussex iron industry was of very ancient date, and reached its greatest importance about the beginning of the sixteenth century, while charcoal was still plentiful. It is believed to have furnished the coffer for the Doomsday Book, and it certainly did the iron which encircles St. Paul's Cathedral. It is stated that at one time no less than 180,000 tons of iron was made on the Weald, chiefly in Sussex, and there was a flourishing iron trade throughout the seventeenth century. Even so late as 1724 the iron trade was spoken of as the chief interest of the county of Sussex, while during the seventeenth century steel was made in several localities, particularly at Warbleton and Robertsbridge. In 1610 there were 140 hammers and furnaces for iron in Sussex, while the last furnace, that at Ashburnham, 3 miles from Battle, was working up to so late a date as 1825 or 1828.

SPECIFICATIONS IN CONNECTION WITH CAST IRON PIPE.

Engineering News, June 11. To show our Foundrymen the modern tendency toward strict specifications where cast iron is involved, the instructions issued to inspectors relative to test bars for cast iron pipe, special castings, and stop valves are given herewith. Besides being interesting, they illustrate the desire to hold foundries strictly responsible for their work, which in turn means that founders are expected to know more about the properties of the metal they use than they formerly did. Here is the item:

Paragraph 12, "Test Bars." Not less than six (6) test bars for cross breaking load shall be made from every heat for 60-inch pipe and special castings, and two (2) test bars from every heat

for pipe and special castings other than 60-inch. These test bars must be taken at different times during the heat in order to show the quality of the metal at the beginning, during, and at the end of the heat, as represented by the material drawn into the ladles and poured into the flasks. Thus, if the heat for 60-inch pipe requires three hours to pour off, a test bar should be run from the first ladle and one every half-hour thereafter during the heat until the proper number of bars are obtained. If the heat consumes six hours, a cross breaking test bar must be poured each hour, and a tensile test bar once each two hours of such heat, or in this order whatever the length of time to pour off the heat for each particular day.

The test bars in each instance must be taken from the same ladle which carries the molten iron from the cupola to the flasks.

If the special castings are not poured from the same cupola as that supplying material for pipe, then the test bars must be duplicated from the cupola supplying the material for special castings; that is to say, if the special castings are for connection with 60-inch pipe, six (6) test bars in addition to the six (6) test bars herein mentioned must be taken from the cupola for special castings.

When one cupola supplies the material at the same time for both pipe and special castings, six (6) test bars taken as described in Paragraph 12, will be held to apply to both the pipe and special castings.

The inspector will be required to see that the bars for cross breaking tests, and the three additional bars cast separately and milled for tensile strength, Paragraph 12, and boxed up and forwarded to this office regularly each day by express.

The duplicate set of cross breaking bars and tensile test bars which the foundry will make, will be broken and deflections determined on the testing machine at the foundry. The inspector will be required to be present when these tests are made and certify to the results, and any casting made from the metal falling below the requirements of the contract, even though otherwise satisfactory, shall be rejected.

STRUCTURAL CAST IRON.

The Association of American Steel Manufacturers has this to say concerning specifications for structural cast iron:

"Except when chilled iron is specified, all castings shall be

tough gray iron, free from injurious cold-shuts or blow-holes, true to pattern and of a workmanlike finish. Sample pieces 1 inch square, cast from the same heat of metal in sand molds, shall be capable of sustaining on a clear span of 4 feet 8 inches a central load of 500 pounds when tested in the rough bar."

These specifications are certainly mild, and would be much treasured by the foundry industry, were it possible to get all buyers to adopt them.

STANDARD TEST BARS FOR CAST IRON.

American Society for Testing Materials. At the recent Water Gap meeting of the Association, Mr. A. E. Outerbridge, Jr., presented a paper on the above subject in which he points out that a metal of suitable composition can be made to show all kinds of fractures if cast in varying thicknesses. Again if a solid block is cast of an iron of any kind, the center would show up much weaker than the surface. Finally, casting the same sized bars with iron under different cooling conditions, different results are obtained. Hence the necessity of uniform conditions in making test bars, and this is the problem with which the Association committee is at present engaged, the results of the elaborate work made for the American Foundrymen's Association forming the basis.

MALLEABLE CAST IRON.

PHYSICAL PROPERTIES OF MALLEABLE CASTINGS, AS AFFECTED BY THE PROCESS.

American Society for Testing Materials. A paper on the effect of the process of manufacture on the physical properties of malleable castings was read by Dr. Richard Moldenke, at the recent convention of that Association. Attention is called to the difference in material when made by the cupola, the air furnace, or the open hearth process, the first named being inferior on account of the contact of the metal with the fuel, and the high heat necessary to anneal. The open hearth gives the best results as the heat is quickest and the chances for oxidation and consequent deterioration of the metal are least, if the crucible process is excepted. The air furnace process by which the bulk of the malleable castings of this country are made today, turns out an excellent material, which fully answers present requirements. In the annealing process the tendency today is to save time at the expense of quality, and hence it will be necessary to insert a clause in malleable specifications, to the effect that all castings must have had at least 60 hours of the full heat. While it is not desirable to use "malleable" with the highest tensile strengths, yet they should run between 40,000 and 44,000 pounds per square inch.

MALLEABLE CAST IRON.

Iron and Coal Trades Review, April 24. We are pleased to learn that Dr. Frederick Siemens, of London, is planning a new departure, by adapting his open hearth furnace for "malleable" purposes. He holds the advantage over the ordinary air furnace to be a saving of 40 to 50 per cent. in fuel, more regular and certain heats, less repairs, cheaper irons may be used, and time and expense saved in making bottom. While the saving, as shown by over 16 years' experience with his furnace for malleable purposes in this country is not as great as he seems to think, nevertheless we are glad to see the introduction of the open hearth furnace for malleable purposes in England. It will be a distinct advance of the industry over there.

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HEATING ANNEALING OVENS.

The Foundry, August. Dr. Richard Moldenke discusses the most economical heating system for annealing ovens. Where natural gas is available, this is undoubtedly the best form of fuel, giving the least loss to the annealing pots. Producer gas, while it does the work well, is a troublesome fuel in the annealing room. With good burning devices things will run properly, but it needs continual watching. Oil, whichever way it is burned, is extremely hard on the ovens and pots, its economy depending upon the Standard Oil Co. Powdered coal seems to be the latest candidate for annealing room favors, and it will be well to look into this promising fuel where the old coal firing is undesirable.

MALLEABLE CASTINGS IN THE STOVE TRADE.

The Iron Age, June 18. In an editorial on the above subject, the following interesting comments are made:

Among the interesting discussions at the Milwaukee convention of the American Foundrymen's Association was that which followed the reading of Dr. Richard Moldenke's paper on malleable cast iron. The stove trade were well represented among the foundrymen present, and they plied the author with numerous questions relative to the fitness of malleable iron for stove castings. The use of malleable iron in the production of ranges especially has increased quite considerably in recent years, and those who adhere rigidly to gray iron for stove plate are nevertheless inclined to look closely into the reasons which have prompted the use of malleable iron, so that they may not make a serious mistake and be left in the rear by more enterprising manufacturers, provided that malleable castings are really preferable for use in this manner.

The trend of the discussion on this occasion was, however, rather unfavorable to the use of malleable iron. Dr. Moldenke stated that while he believed that a promising field existed in its use in the manufacture of stove legs and other parts requiring strength, and not carrying considerable ornamentation, he could not see much of a future in its use for stove plate. It is not so capable of withstanding the effects of intense heat as gray iron, and in the annealing process the sharpness of outline so desirable in the fine molding now used in making stove plate is largely lost. Even in the parts requiring strength he was of the opinion that pressed

steel might ultimately be found as satisfactory as malleable iron, and would perhaps win preference on account of its lightness.

Referring to the use of malleable iron for water backs or water fronts in ranges, Mr. Magee stated that the experience of his company had been very unsatisfactory. They had been induced to try malleable castings for this purpose and sent out several thousand ranges fitted with them. Complaints of their bad condition then began to come in and eventually the company were obliged to replace all of them. The cause of the trouble in this case was leakage owing to rust, malleable iron oxidizing much more rapidly than gray iron.

The fact, nevertheless, cannot be lightly dismissed that malleable iron is making distinct headway in displacing gray iron in the manufacture of stoves. It may not be suitable for water heaters, and it may not be adapted to purposes of ornamentation, or to the construction of parts subjected to intense heat, but its superior strength constitutes a very good "talking point" for those who are seeking every possible advantage over their competitors. The pioneers in this direction were able to sell their goods at high prices by demonstrating the ability of their ranges to be thrown from a wagon to the ground without breakage, and such parts as lids, for instance, to be struck with sledge hammers without cracking. Such evidences of durability were sufficiently convincing to effect sales, and other manufacturers have met with commercial success in working along the same lines. That the movement in this direction is growing is demonstrated by the fact that manufacturers who have hitherto adhered rigidly to gray iron for cast parts of their stoves and ranges are looking into processes for the profitable production of malleable castings on the limited scale suited to their requirements. It appears to be a condition that is confronting the stove trade and not a theory. This may be another instance in which practical progress defies the experts."

To the above must be added that, of course, when it comes to selling propositions the experts making materials best suited for the work in hand must retire gracefully. Undoubtedly in the middle West, there is a large sale for stoves made of malleable cast iron; indeed "malleable" is as common as gray iron there, is made well, and cheaply. With increasing demands for art in the homes of our western workingmen, a reaction will set in, and the artistic stove plate as we know it from the East will regain the ascendency it

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merits, provided, that the price is not kept artificially high by combinations the malleable trade would not stand for. Further than this, it is not an easy or profitable matter to make malleable castings in small quantities, and evidently where the malleable stove holds sway, the profit is based somewhat on freight rates from the East.

LARGE ANNEALING OVENS FOR MALLEABLE CASTINGS.

The Iron Age, July 1st, illustrates the mammoth annealing ovens built in the works of the Northwestern Malleable Iron Co., of Milwaukee, Wisc. As these hold 90 of the ordinary pots, they can certainly be called "mammoth," the clear interior floor space being about 19′ x 22′. The construction is exceedingly heavy, involving 140,000 brick per oven, plus 1,700 cu. ft. concrete. Also 39 tons of metal. Coal is used for firing, and the induced draft system supplants the usual chimney.

ANNEALING WHITE CAST IRON.

The Iron and Machinery World, Anniversary Number, 1903. Dr. Richard Moldenke goes into the many so-called quick malleable and steel processes. These depend upon a higher annealing heat given the hard iron, which under ordinary processes would make plain malleable castings. The difficulty with all these quick processes is the lack of uniformity of product, which makes trouble for the buyer. As a general proposition we have it that the higher the heat, the shorter the anneal. But—the composition must be such that annealing will take place at all. That is to say, a seven day anneal at 1350° F. will be one thing, and a twenty-four hour anneal at 1700°, which should be the same theoretically, in reality is another thing. Now as the hard castings for regular malleable work may vary from 0.33 to 1.25 silicon according to their thickness, and sulphur from nothing to 0.13, it is easy to see how trouble may come to the manufacturer who goes out of the beaten track in making his malleable castings.

PHYSICAL TESTS OF MALLEABLE CAST IRON.

Van Nostrand's Engineering Magazine, April, 1885. As far back as this date we find recorded tests of malleable iron castings, which in view of the present state of the art form a very valuable medium of comparison. Prof. Palmer C. Ricketts is the authority for the tests here given. Tests were made on cast iron side by side with those of "malleable," though the former, not being accompanied by analyses, give no means of identification as to the quality. Ten tables are given in all, the results of which are summarized as follows: Bars ¾" square ran 30,970 to 44,290 lbs. per sq. in., with an elongation of 1.8 to 7.6" in 5 inches. With malleable cast iron bars, 1 by ⅓", strengths from 32,750 to 36,990 lbs. per sq. in., were obtained. Round ½" bars of malleable stood 36,200 to 44,680 lbs. per sq. in. Bars of ¾" diameter gave 28,570 to 40,860 lbs. per sq. in. Where the skin was removed from bars originally ¾" diameter, we have strengths from 26,430 to 34,600 lbs. per sq. in. remaining in the material. In compression, half inch cylinders and half inch cubes gave an ultimate compressive strength of 108,900 to 160,950 lbs. per sq. in. The figures given here will illustrate very nicely the progress made since 1885. Half inch bars should run about 52,000 to 59,000 lbs. per sq. in., and the larger sizes from 42,000 to 47,000 lbs. per sq. in.

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ALLOYS.

ALUMINUM CASTINGS.

The Metal Industry, August. Much of the difficulty with aluminum castings can be laid to the door of the zinc-aluminum alloys. These are cheap, easily melted, and look stiff and strong. An alloy of aluminum 3, and zinc 1 is about the best of these, giving a tensile strength of 35,000 lbs. per sq. in. There is, however, much red-shortness in these alloys, and only loose ramming of the sand, good gating; and cold pouring will get out the castings properly. Thin work, which must be run hot, naturally cracks. Hence for this material it is best to use the copper-aluminum alloys in place of those of zinc. Such castings do not crack so easily.

EQUIPMENT OF BRASS FOUNDRIES.

American Machinists, July 2. The equipment of brass foundries is taken up by Mr. C. Vickers, of Chicago. He holds that this should be done solely with a view of looking out for the particular work to be done in it, and not with any other possibilities in mind. Where light and heavy work is to be done at the same time, arrangements should be made to have large and small furnaces as well as coarse and fine sands at hand, otherwise the losses on one class of work will offset the gains on the other. As a rule it is better to use small pots for brass heats than large ones, as the metal in the latter is apt to chill too quickly. Where colder metal may be cared for this objection falls away. It will be readily understood that getting out larger castings in shops with small pots and similar equipment, disastrous results cannot but occur as no mold can be poured without interruption. Scabs are the rule, and necessary clamps and tools are absent. The stall system of bench molding is the rule where car journal bearings are made, as this is the most convenient system for the large quantity of sand to be handled. The bench should be located as near to one of the wooden walls as possible, so as to leave room to get around the molds. A cope being lifted off, can be thus conveniently placed on the shelf, and need not be carried away. The stall system though convenient, is quite wasteful of sand: and hence where smaller work is the rule, the

tub is to be preferred. Sand is usually mixed and sprinkled hot. It is left to soak a few hours and can be used directly for machine work. For hand molding it is usually cut over once more. The finer the grades of sand are always riddled for safety. Mr. Vicker's experience has been that the tub is preferable in any case to the bench except when large car castings are to be made.

POROUS BRASS CASTINGS.

American Machinist, August 6. The veteran brass founder, Mr. Chas. Vickers, handles this question in his usual able manner. Porosity is caused by the presence of oxides in the metal, hence the quality of the copper used must be carefully watched. Copper wire is often ruined for brass making purposes by the burning off of the insulation in such a way that the surface comes out thickly coated with oxide. Scrap wire must therefore be perfectly bright and clean. For important work use only ingot copper, melt it under charcoal, and never let it become overheated. Use some phosphor-tin, say ½ lb. to each 100 lbs. of the melt, to help deoxidize the metal, and always melt new metal twice before using.

MELTING RATIO IN BRASS FOUNDING.

The Foundry, September. Mr. John F. Buchanan discusses a subject of which we hear very little. The melting ratio for the iron foundry is always in controversy, but for brass this is different. He calls attention to the fact that the melting ratio in the brass foundry is not a question of economy only, but the nature and requirements of the work must be specially considered, and the effect of the fuel on the metal and crucible or furnace looked into. Here is a table recording some of Mr. Buchanan's experience along this line of investigation.

Metal melted, lbs.	400	400	400	400	17,305	2,240
Method used	Crux.	Crux.	Crux.	Crux.	Cupola	Reverb.
Draft - -	Nat'l	Nat'l	Forc.	Nat'l.	—	—
Fuel - - -	Charc.	Purif. Coal	Purif. Coal	Coal	Purif Coal	Coal
Quantity - -	318	300	348	325	2,184	1,768
Per cent. loss in melting	80	1.22	2,18	1.04	7.93	3,57
Melted metal per lb. fuel	1.25	1.33	1.12	1.20	7.91	1.26

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CASTING MANGANESE BRONZE.

The Metal Industry, September, contains an article on casting manganese bronze which is interesting to brass founders. As the alloy contains about half of its weight of zinc and some aluminum, it is difficult to cast. Dry sand molds should be used if possible, though green sand will give passable work. The metal is best melted in crucibles well covered with charcoal, and should not be "burned." Pour as hot as possible without producing a rough skin, and skim well before pouring. Use skim gates to get off the dross, and keep the basin full all the time while pouring. Heavy feeders and risers are necessary, as the shrinkage in manganese is great. The head is not as important as the bulkiness of the feeders. Attach them to the top of the thickest part of the casting, making the necks as thick as possible. Attach the runner to the lowest part of the castings, making the metal flow upward into the mold. Cast all working surfaces downward, or if unavoidable to have them on top, leave extra metal to plane off. Add 1½ lbs. zinc each time the metal is remelted in crucibles, or 4 lbs. to the 100 if in the reverberatory furnace. This represents the melting loss in good practice.

PHOSPHOR BRONZES.

The Foundry, September, gives two formulae for Phosphor Bronzes. Copper 89.5, tin 10.0, phosphorus 0.5. Tensile strength of this mixture 36,800 lbs. per sq. in. Elongation 9 per cent. in 8 inches. The other mixture is: copper 89.9, tin 10.0, phosphorus 0.1, and the tensile strength similarly 40,000, with 25 per cent. elongation in 8 inches. It is interesting to note the effect of phosphorus on the elongation and tensile strength.

NOTED MEN IN THE FOUNDRY WORLD.

THOMAS D. WEST.

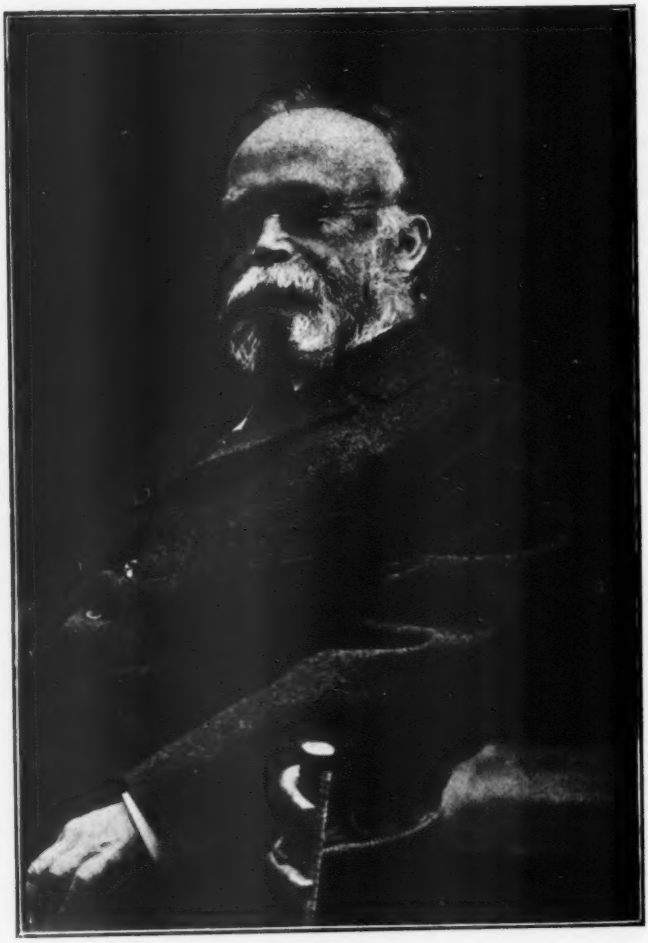
It is but fitting that the first page of our enlarged Journal be graced by the portrait of the man, who more than any other has labored to place the foundry industry on the high plane we find it today. Twenty-three years ago when he began his aggressive campaign for better foundry education, he little realized how difficult it would be to awaken an industry which today in spite of all that may be said for it is still the most backward of the entire iron industry. Perhaps, therefore, he must now feel great satisfaction in seeing the clouds roll by, opposition to advanced ideas disappear none the less surely because slow, and his disinterested labors for the good of the apprentice, the molder, the manager, and the owner, appreciated and extolled.

Wherever foundrymen congregate, the name of Thomas D. West is heard, his books are to be found in every progressive foundry and in the molder's home, his face is familiar to all. From his early boyhood, Mr. West has been so busily engaged in hard work, that only now is he seeing his broad ideas on founding being realized in his own establishment. In enlarging his foundry, which makes ingot molds a specialty, and running it on the continuous plan, not only is an excellent example of modern foundry equipment given to the world, but an actual capacity of 1,000 tons daily provided for, a thing which will be monumental in the history of the foundry world.

Thomas D. West was born in Manchester, England, August 31st, 1851. Coming from an old English family (from his mother's side, a Faraday, of scientific pre-eminence) his tastes were naturally of an investigative turn. His parents came to America when he was six months old, and put him into the foundry at the age of ten, since which time he has been constantly identified with the foundry industry. Mr. West has had a most varied career, being a true "Journeyman," working in the best of foundries and at the most intricate of work. Even when already foreman, he was so young that for a long time the title "boy foreman" appeared to

stick to him. From that time on Mr. West took charge of important work until he started for himself under the firm name of The Thomas D. West Foundry Co. Mr. Geo. H. Boyd came in later as President, Mr. West being Vice President and Manager. A three years' fight with the union ended in the burning down of the works, the company eventually removing to their present site at Sharpsville, Pa.

It is chiefly as a writer on foundry topics that Mr. West is known to the industrial public. His first article appeared in the *American Machinist*, June 15th, 1881. Since then he has spent his best years and all the time after working hours in bringing out the material which is collected in his three books of world-wide reputation. In addition, many an article, lecture and discussion has come from his fertile pen. He is an active and honorary member of many associations, and is the originator of the Standardizing Bureau of our Association, which is doing such creditable and useful work for the whole iron industry.



A. Ledebur

For Biographical Sketch of Prof. Ledebur see page 441.

Journal of the American Foundrymen's Association.

EDITORIAL COMMENT.

MIXING "OFF" IRONS WITH FERRO-SILICON.

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Managing Editor, DR. RICHARD MOLDENKE, P. O. Box 432, New York City.

ASSOCIATE EDITORS:

THOMAS D. WEST, Sharpsville, Penna.
HERBERT E. FIELD, P. O. Box 104, Ansonia, Conn.
S. H. STUPAKOFF, 545 Turret St., Pittsburg, Pa.
JAS. A. MURPHY, 114 W. 20th St., Erie, Penna.
WM. H. PARRY, 664 E. 31st St., Brooklyn, N.Y.
KENNETH FALCONER, 34 Staynor Av., Westmount. Montreal, P.Q.

EDITORIAL COMMENT.

MIXING "OFF" IRONS WITH FERRO-SILICON.

Our attention was recently called to some statements on the effect of silicon in Mr. Patterson's address on the "Quality of Pig Iron," delivered before the New England Foundrymen's Association. After very properly and correctly describing the softening effect of silicon by promoting the formation of graphite, Mr. Patterson expresses surprise that foundrymen as a body do not take advantage of this property and use high silicon irons to mix with the so-called "off" grades, instead of persistently sticking to the standard and high priced foundry irons as we know them.

This query is justified, and the answer lies near at hand. Theoretically a high silicon iron mixed with a low silicon metal to form the proper average would be highly advisable, and the mixture could be made several dollars a ton cheaper than if straight foundry irons with say 2.50 per cent. silicon contents, and the usual proportion of scrap, were used. Practically, however, it is not a safe thing to mix extremes in composition in the cupola, and hope for uniform results therefrom unless special precautions are taken and kept up. But granting that this desirable result is always obtained, the so-called "off" grades are usually so badly "off," that the scrap pile, after cleaning up the day's work soon demonstrates that this material is expensive at any price.

As a matter of fact there is much of the human element which

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enters into the cupola calculations. The mixing may not be done correctly by the weighers, the distribution of the charges in the cupola may be, in fact usually are, far from even, the tapping may take out high silicon iron at one time, and melted scrap at another. The interposition of the Bull-ladle, or in Europe the Fore-hearth, will in a measure overcome this, but suppose the purchasing agent buys these "off" irons, the chemist mixes them well, and the foundry is not given the bull-ladle. Is it not true that three fourths of our foundries do not even possess a large bull-ladle, but use a big shank for the purpose? Our conservative foundrymen, therefore, let well alone, and stick to the old number twos.

It must be added that when the ordinary classes of castings, say those with 2.15 silicon are made, the introduction of the high sulphur and oxidation products always coming with the "off" irons is a very serious matter, as there would be too little ferro-silicon added to dilute this, the latter being guilty of an overabundance of sulphur and phosphorus in most cases.

In only one instance is it advisable to mix ferro-silicon with low silicon (but not "off") irons. This is when the silicon in the castings to be made should approximate 3.00 per cent., and the shrinkage should at the same time be at a minimum. In other words for small castings with chunky parts, which are to be machined, and must be sound. Here we have the close grained structure of the harder irons retained in a great measure, even with the higher silicon contents produced by the ferro-silicon. Had 3.00 to 3.50 per cent. silicon iron been used for the mixture only, a very open structure would have been the result.

The use of "off" irons should, therefore, be restricted to the less important classes of castings, and be bought only by those who can handle them to advantage. Undoubtedly it is possible to mix extremes in composition, and get good results, but the conservatism of the great majority of our foundrymen will compel the making of high grade foundry irons, which need no close watching, for a long time to come.

CUPOLA AND FURNACE REPORTS.

In our last issue we extended a cordial invitation to our members to ask questions. We did this to stimulate interest in foundry matters, and thus bring up thoughts which would stand dis-

cussion and yield substantial returns in the way of solid information. Let the matter be as simple as it may, there is always someone who can profit by the mere suggestion that a little light is wanted. Our readers therefore need not hesitate to ask, for we all can learn quite a lot yet in this complicated foundry business of ours. We hope therefore that no one will hesitate to drop us a line because he thinks the information wanted too elementary. We will freely confess, that just these little elementary things which look so innocent are the most difficult to answer.

Here is a question which we have all asked ourselves, and all of us who want to know what we are doing in the foundry have some method of answering it. We quote from the letter sent us: "We desire to have in as much detail as practicable, all information regarding our cupola and air furnace departments * * and without making a fad of this matter, and going to undue expense, wish to keep posted."

The above explains itself, and is in addition an excellent example of sound business sense which could be well applied to every department of the foundry. We should not encumber our records with details which make the work more of a fad than a basis for shop costs. We should not keep an army of clerks piling up records which are never used. But we do want simple and effective methods which tell the story almost at a glance.

We therefore invite our friends to send in their cupola and furnace sheets, for classification and discussion in some subsequent issue, care being taken by us that the names remain confidential.

FOUNDRY LITERATURE.

The unusually active interest now being taken in the Foundry Advance all over the world seems to be stimulating our wide-awake literary friends over on the other side to greater efforts in the way of foundry publications. The latest candidate for foundry favors is called "Giesserei-Zeitung," and is a semi-monthly publication covering the whole of the industry. It is well gotten up, and will no doubt find favor in its special field. There are now two specific publications for the foundry in Germany.

We are further informed that the world-wide known Journal, "Stahl und Eisen," is arranging for a special department to cover the foundry field, the first issue to appear in January. The edito-

rial part is in charge of our fellow-member, Dr. F. Wuest, professor of Metallurgy at the University of Aix-la-Chapelle, and well known as an authority in his profession.

We cordially welcome this vigorous activity on the part of our German friends and competitors, and hope that much good will come of it for the foundry industry of the world. Over here, while there is enough activity in the way of foundry investigation, there is not sufficient support to make this as effective as it should be, and our Journalistic tendencies are all toward consolidation, rather than expansion. The field is well covered by "The Foundry" and our own Journal, and there would hardly be room for any more.

What we would like to see is such support to the movement that the present publications can be enlarged, made more useful, and be spread further, so that no foundryman need have an excuse for not knowing what is going on in these rapidly changing times.

FOUNDRY FORMULAE.

From far off Sidney comes a plea for more foundry formulae. Our good friend John F. Buchanan, so well known as a writer on foundry topics, calls attention to this fact in a forcible manner in the course of an able argument given on another page of this issue. But like a general, he not only deplores the lack of this form of foundry literature, but sets about to remedy the defect.

We wish him success in his undertaking. We hope to get from him a first class hand-book for foundrymen, giving rules and tables, suggestions, and other people's results as well as his own.

Mr. Buchanan asks the help of everybody in making this work he is engaged upon as complete as possible, and whatever may be sent to us for him will be promptly forwarded to New South Wales.

THE FOUNDRY EXHIBIT IN ST. LOUIS.

As we go to press there will be circulated much information on the long-projected exhibit of the American foundry industry at St. Louis. Too much praise cannot be given Dr. J. A. Holmes, the energetic chief of the Mines and Metallurgy department of the

Exposition, for the painstaking and persistent work he has done for our industry in its proposed representation.

It is up to the foundrymen of the country to assist the cause by contributing to the erection of a suitable building to house the exhibits, provide a headquarters for visiting foundrymen, and to afford an opportunity to the exhibitors to show their foundry machinery in actual daily operation. The St. Louis foundrymen have promised to furnish molders, turn and turn about, to man the benches and floors, so that the production in iron of stove and art work, brass, and aluminum castings can be shown the general public, who have no idea what a foundry looks like. Naturally there will be no heavy tonnage produced, and souvenirs will be made in plenty, to help defray the expense.

The running and exhibit end will be cared for amply by an association of prominent supply houses, but as they cannot be expected to bear all this responsibility, and erect the building in addition, we are asked to contribute to the extent of 10,000 dollars to get everything into working order, after which the exhibit will be cared for and maintained.

The time is short, and our members and friends, who are willing to help advance the industrial importance of the foundry in the eyes of the public, the legislatures, congress; and also give the less favored member of the trade an opportunity to see modern appliances, is asked to send his promise to contribute to the Secretary, or to Dr. Holmes, or to the secretary of his local association, and when enough is pledged to make the undertaking a success, he will be asked to send his subscription, and not until then.

For the credit of the industry we hope for a generous response.

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METALLURGY

Edited by HERBERT E. FIELD, P. O. Box 104, Ansonia, Conn.

Questions, comment and criticism are invited. Kindly direct all correspondence for this department to Mr. Field.
The Instruction Papers of this department are sold at the uniform price of ten cents a copy. Founders and others desiring them in quantity can get them at $2.00 per hundred. Send remittances to American Foundrymen's Association, P. O. Box 432, New York City for prompt shipment.

ECONONY IN BUYING, MIXING AND MELTING IRON.

In a paper before the Pittsburg Foundrymen's Association, November 2nd, Mr. H. E. Field thoroughly discusses the above subject. Under economy in buying he calls attention to the advantages of buying by analysis, and recommends restrictive clauses in the buying contract which would give the buyer the option of rejecting the iron or accepting it at a reduction to be determined by the price which the grade received would have brought at the time the iron was bought. For example an iron running 2.50 to 3.00 per cent. in silicon is bought for $16.50 per ton, the price of an iron running from 2.00 to 2.50 in silicon at the same time being $16.00. When the iron is received if it is found to run 2 per cent. in silicon, the price to be paid by the founder according to the contract would be $16.00 as against $16.50 for the 2.50 grade. Mr. Field points out that when the supply exceeds the demand, competition will do all that specifications can, but when the demand exceeds the supply and it is difficult to get anything in the shape of pig iron, we need some guarantee that we will get what we order or its equivalent. The writer calls attention to the fact that great judgment should be used in making out specifications; they should be as liberal as possible and still fulfill the requirements of the buyer. Four factors are mentioned as determining what brands of iron are most economical to buy; first, local conditions; second, suitability as to composition; third, uniformity; and fourth, economy in handling and melting. Under local conditions the price and available supply of scrap and the distance from pig iron supply were mentioned. Under suitability as to composition, the writer spoke of the fact that at a mutual cost irons which ran the nearest to the composition required, should be bought for it is easier to get a correct mixture with such irons. The practice of buying odd lots of iron was said to be economical in so far as these irons could be

mixed with others having the properties they lack and the mixture of the two be lower in price than a single brand of the required composition. In determining what irons are best suited for certain work it should be kept in mind that in castings to be machined, the softest iron which will give the required strength is the most economical. As an exception to this, heavy castings with but little machine work on them were mentioned. It is therefore advisable to select irons which will most economically combine economy in price with ecomomy in cost of machining. The writer held that the uniformity in the iron bought was an important factor. The advantages of machine cast iron in this direction were discussed at length.

Under "Mixing Economies" the writer stated that mixing by analysis was synonymous with mixing economically provided it was carried on under favorable conditions. The writer dwelt upon the fact that the mixing should be in the hands of some one fitted for the work by education and experience, and argued that a knowledge of mixing iron for one grade of work did not imply an ability to mix it for all grades. As an illustration the speaker asked those present if they would expect a bench molder to make a success of his first loam job. Why then should a chemist taken from a steel laboratory be expected to make a success of mixing cast iron? Many failures laid to some unknown conditions unaccounted for by chemistry were said to be due to the inexperience and lack of knowledge on the part of the one who sought to apply the chemistry. The poor facilities of our technical and trade schools for turning out capable foundry metallurgists was referred to and the opportunity opened to Pittsburg foundrymen in the new Carnegie Institute was mentioned with the hope that a proper course of instruction in foundry metallurgy will be installed in its curriculum.

In regard to what can be expected of an accomplished foundry metallurgist, Mr. Field says, "Economy can in the light of our present knowledge demand of the expert metallurgist that he produce at the least cost the best possible product for the work intended, the cost of machining should be taken into consideration as well as the cost of mixing. He should be able to eliminate a majority of the ills so common to cast iron and when they do appear he should be able to distinguish the cause of the defect and to eliminate it. He should know whether a pattern was properly

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constructed for an economical production of the casting as far as the iron is concerned; he should be familiar with all the different compositions necessary for the many varieties of special castings, each of which requires properties peculiar to itself."

The speaker called attention to the great number of different grades of cast iron and stated that iron which was just suited for one grade might be very unsatisfactory in another. Iron that makes soft, strong, light castings, makes rotten, spongy and weak heavy castings. While speaking of obtaining good results from the chemical methods of mixing iron, the speaker said, "No one, however expert, can change the quality of the iron which he is to use. He cannot remedy a defect due to high phosphorus, if he has not the means of reducing it. If high silicon is needed to improve your product, he cannot create it out of the atmosphere. In other words he must be supplied with the necessary materials to accomplish what he is set to do. These are frequently less expensive than the ones he is given to work with."

In discussing "Economy in Melting," Mr. Field refers to the location of the foundry, and the amount of tonnage as foremost factors in economical melting; the advantages of travelling cranes with crane scales covering the pig iron yard was commented upon. When such was not possible, the use of weighing cars with exchangeable tops was recommended. The means employed in moving the melted iron from the cupola spout was considered in connection with its influence on the condition of the iron as obtained from the cupola. With rapid conveyors, duller iron may be used, than when a long time is consumed in carrying the iron from the cupola to the mould. It takes more fuel to produce hot iron than it does dull iron. This excess of fuel means an increase in sulphur, which will require the use of less scrap and hence an increase in expense. The different methods of classifying scrap and runners and the difficulty in obtaining comparative costs of mixtures were discussed. The advantage of large, rapid melting cupolas was mentioned as giving a longer molding day, and hence a saving in labor.

The paper concludes with a comparison between the cupola and air furnace for making strong iron, the writer contending that by mixing by chemical analysis the strongest air furnace iron could be duplicated in the cupola. He stated that the strength of an iron depended upon its chemical composition and that the

composition giving the highest strength could be more economically produced in the cupola. The cupola was said to be less effected by weather conditions. A complete and thorough knowledge of the mixing of iron, of cupola changes and of the composition which would give the required strength in different thicknesses of castings are necessary to produce such results.

A spirited discussion followed the reading of the paper. Exceptions were taken to the statements made in the paper concerning high strength irons made in the cupola. In substantiating the facts given there I present below a series of tests made from cupola iron under my personal direction. The tests were made under gevernment inspection for government work. Ten consecutive heats have been taken and all the tests taken from those heats are given below in order to show the regularity of the heats. The specifications required a minimum tensile strength of 28,000 lbs. per sq. in. The specimens were all turned from plugs specified by the government and were in almost every case over 2 inches in thickness and were turned down to a 1 inch area for breaking.

The figures given below are pounds per square inch.

1	2	3	4	5	6	7	8	9	10
29,700	29,900	30,000	32,700	34,600	29,900	31,000	32,500	32,700	30,700
33 000	34,000	28,000	32,500	37,900	32,300	32,000	34,700	44,000	32,600
27,000	32,000	30,700	32,700	37,100	32,600	31,400	30,200	43,300	33,900
35,400	33,000	31 000	27,500	37,800	34,000	32,000	32,000	33,800	29,800
32,400	29,800	34,800	29,300	35,000	31,800	31,900		30,500	33,000
31,000	28 900	33,300	30,000	30,000	30,500	32,800		31,000	
31,100	29,900	32,100	28,100	32,000	32,000	34,700		39,980	
34,700	28,900			31,000	31,500	30 200		31,400	
	29,500			33,000	32,800	32,000			

"TROUBLE WITH IRON AND COKE SAMPLES."

Mr. George B. Davis presented a paper on the above subject before the Philadelphia Foundrymen's Association, on December 2nd. Mr. Davis calls attention to the increase in the number of foundries using analyses of their iron and coke, and hence the growing importance of the above subject. He cites many examples of contaminated samples and claims that too little care is exercised in collecting and drilling samples of pig iron. He states

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that samples frequently came to the commercial laboratory mixed with oil, waste, and sand. An instance of a sample containing sand causing the results of a chemist to be doubted was spoken of. Poor methods of packing the sample also came in for Mr. Davis' criticism. Errors due to the graphite and finer parts of the sample sifting out of the envelope and of the packing becoming broken, are mentioned as illustrations of this point. In sampling pig iron Mr. Davis recommends placing the pigs on end, on a drill press and removing the drillings with a magnet or else placing the pigs horizontally in a lathe and catching the drillings on a paper.

The subject is a timely and important one. The A. F. A. has already recommended certain specifications for the sampling of pig iron. These are open to the same criticism as is Mr. Davis' suggestion, viz., that the drillings be removed from the top of the pig with a magnet. When this is done a certain part of the drilling, principally graphite, remains behind, unattracted by the magnet. This prevents obtaining a uniform sample, or rather a correct sample, especially when carbon determinations are required. I find that the most satisfactory way to sample pig iron is to have the pigs broken, then to have the loose sand removed from the outside of the pig. It should then be wrapped in strong paper and tied at the end near the fresh fracture. This prevents any sand getting into the sample and allows all of the drillings to be used. Samples thus selected need not be treated with a magnet.

THE CHEMISTRY AND PHYSICS OF CAST IRON IN THE LIGHT OF RECENT KNOWLEDGE.

American Machinist, October 8 and October 15. Mr. J. E. Johnson, Jr., refers to the advances made in the Chemistry of Cast Iron in the past few years. He takes up the old question of whether iron gains or loses carbon in passing through the cupola and refers to a previous article in which he maintained that iron lost carbon in melting, and to some work of Mr. West's in which the latter showed examples of the iron gaining in carbon when melted in the cupola. He refers to a statement by Prof. Ledebur, who states that total carbon may increase or decrease, and admits that this statement is probably correct. The writer endeavors to explain why light scrap gives harder iron than heavy scrap of the

same composition when both are remelted. He states that the light scrap melts more readily and remains longer in contact with the fuel after melting and thus absorbs more carbon and sulphur which raises the total carbon and sulphur and hence causes the casting to be harder. The writer discusses the piping of an ingot in steel making and mentions the fact that oxidation of the iron is liable to occur in the making of pig iron in the blast furnace. The evil effects of nitrogen are mentioned and the beneficial effects of titanium which is said to eliminate the nitrogen and to greatly improve the iron. The second section of Mr. Johnson's paper reviews papers of Prof. H. M. Howe, A. T. Child and W. P. Heineken, and Messrs. Charpy and Grenet. The effects of sulphur and manganese are considered. In regard to the latter the writer states that manganese diminishes the evil effects of sulphur; that it is not objectionable up to 1 or 2 per cent. on account of its hardness; that it is more apt to soften on account of its action on sulphur, than it is to harden of itself. Phosphorus is said to make iron brittle, to reduce shrinkage and to lower the melting point. He states that sulphur throws the carbon into the combined state; it makes iron weak and rotten, and it causes high shrinkage and strains. Mr. Johnson contends that silicon softens only up to 2 per cent. and makes a strong plea for lower silicon, lower sulphur irons, in preference to those higher in silicon and sulphur. He states that foundrymen try for too high silicon, and recommends for general castings an analysis as follows: the casting to analyze in silicon under 2 per cent.; sulphur under .04 per cent.; phosphorus .6; and manganese 1 per cent.

As a strong argument in favor of low silicon iron the writer calls attention to the fact that a foundry using direct metal from the blast furnaces made satisfactory castings which never ran over 1 per cent. in silicon and would average about .75 per cent. the year round.

The problem which Mr. Johnson refers to in regard to iron losing or gaining carbon in going through the cupola has been previously thoroughly discussed before this Association. An iron high in carbon, high in silicon, melted with low fuel percentage and heavy blast tends to lose carbon in remelting. Iron low in carbon and silicon, melted with low blast and high percentage of fuel tends to gain in carbon. Whether the iron gains or loses carbon de-

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pends upon which of the above conditions predominates. The statement that an increase in total carbon increases the hardness is erroneous. Other elements remaining the same, an increase in total carbon means a decided increase in the softness of the iron. The use of manganese up to 2 per cent., as suggested by Mr. Johnson, would not be safe in light castings on account of its hardening influence. After the manganese has counteracted the evil effects of the sulphur, the balance tends to form a hard carbide with the carbon, which makes the iron difficult to machine. The manganese should be present only in sufficient quantities to neutralize the effect of the sulphur. In his treatment of sulphur, Mr. Johnson omits from his consideration any thought of economy. A founder could, in truth, use low silicon iron, low in sulphur, but if he used them as low as recommended, he would have to run a minature blast furnace (instead of a cupola) with its high temperatures and heavy slag, and he would then have to sell his scrap. .04 per cent. in sulphur is a pretty low limit for cupola iron. This is especially true when one consideres at the outset blast furnaces will not guarantee under .05 and that the iron picks up from .02 to .06 in sulphur in passing through the cupola. In his illustration of using direct metal, Mr. Johnson has entirely left out of consideration the carbon. Irons, such as he mentions, are generally high in carbon, and this high carbon makes up for the lack of silicon. A casting with .75 silicon and 3 per cent. total carbon would be difficult to machine even if the sulphur were very low. .75 in Silicon and 4 per cent. carbon with low sulphur could be readily machined especially in large work.

The article is a valuable contribution, but it is written from a blast furnace standpoint, giving almost no consideration to foundry conditions. Science may eventually produce a low sulphur iron from the cupola by the use of manganese or manganese ores. This would allow somewhat lower silicon. In a previous article I have called attention to the fact that just enough silicon should be used to force into the free state just the amount of carbon desired in that condition for the casting in question. Any more than this exerts a weakening influence. The higher the sulphur in a casting and the lower the total carbon the higher the percentage of silicon required to perform this function.

THE CONDITION AND ACTION OF CARBON IN IRON AND STEEL.

American Institute of Mining Engineers, October, 1903. Mr. H. E. Field reviews the effect of carbon on iron and steel and advances theories as to the form of the carbon in iron and as to the reasons for its hardening action in quenching from high temperatures. In reviewing he calls attention to the fact that pure iron is soft, malleable and easily welded; that it cannot be hardened or tempered as those terms are generally construed, and that it is unfit for casting on account of its lack of fluidity. From this he concludes that the properties which make iron so valuable as a commercial product must be due to impurities within the iron. The properties of carbon which make it valuable in iron and steel are recalled as follows: it is a non-metal; it is very stable and has not been melted; it occurs in three modifications; and it is believed to have a molecule containing a large number of carbon atoms. Hardening carbon is spoken of as the form of carbon existing in hardened steel. Carbide Carbon as that form existing in unhardened steel, and more or less in all forms of iron. It is produced when iron containing hardening carbon is cooled slowly through the degrees below 700 C. Temper carbon is the form of carbon formed in an iron containing hardened carbon when that iron is heated at a high temperature for a sufficient length of time. Graphitic carbon is said to be more fully developed temper carbon. Attention is called to the fact that there is no definite line dividing hardening, temper and graphitic carbon.

Mr. Field states that pure iron, under maximum conditions, will dissolve about 6.67 per cent. carbon, and that when iron so saturated cools, its ability to hold the carbon in solution decreases and the carbon separates out as graphite or temper carbon; the slower the cooling, the more will be separated out. The separation of this carbon evolves heat which prolongs the cooling. The writer contends that carbon in the hardening condition is in the atomic state; the breaking up of the carbon molecule being caused by the combined action of the heat and the melted iron, and that it may be retained in this condition by sudden cooling. He advances the following as indicating the correctness of this theory: Iron containing hardening carbon evolves more heat when treated in a calorimeter with mecuric chloride or copper ammonium chloride than

when the carbon is in any other condition; acids unite with hardening carbon to form hydro-carbons; hardening carbon will unite with iron to form carbide-carbon (Fe_3C)., when heated to temperatures below 700 degrees, and that at higher temperatures the hardening carbon will unite to form temper carbon. The writer reviews the two debated theories as to the cause of the hardening of steel and advances a new theory, viz., that the hardness is due to three distinct reasons. First, the inherent hardness of the carbon atom; second, the position of the carbon atom, and third, the attraction existing between the carbon atoms. The latter is said to give that peculiar hardness known as hardened steel. The writer likens the iron in the solid state at high temperatures to a solution and calls attention to the theory of solution, which supposes that the particles are free to move in and about one another, but still have an attraction for each other. At a high temperature the particles of carbon are assumed to be able to move thus freely about one another but to still have an attraction for one another. If the iron is suddenly chilled from this high temperature, the solidifying iron will prevent the particles of carbon from coming together. They will, however, retain this attraction for each other and this attraction is assumed to bind them together into the hard body which we know as hardened steel.

TESTS OF STEEL FOR ELECTRIC CONDUCTIVITY, WITH SPECIAL REFERENCE TO CONDUCTOR RAILS.

American Institute Mining Engineers, October, 1903. Upon the above subject Mr. J. A. Capp says that the third rail is preferable to the overhead trolley for electric railway work in many instances. He further states that the production of a rail which will most economically combine high conductivity with low resistance and good wearing properties would be of great benefit in third-rail work. It was with the object of determining just what composition would best fulfill these requirements that the present investigation was undertaken. The following general conclusions were arrived at by Mr. Capp:

The conductivity decreases and the resistence increases as the percent of carbon and manganese increase; the wearing properties decrease as the percentage of carbon and manganese decrease;

hence, high efficiency in wearing is produced by exactly the opposite conditions from those which result in high conductivity and low resistence. A steel of the following composition is suggested as best fulfilling these requirements:

Carbon not to exceed .15	Phosphorus not to exceed .06
Manganese not to exceed .30	Silicon not to exceed .05
Sulphur not to exceed .06	

This should be interesting to the Cast Iron metallurgist inasmuch as he is frequently called upon to produce a cast iron of certain electrical properties. Heat conductivity closely follows electrical conductivity and the relative conductivity of different grades of cast iron for heat determines its utility for many special purposes.

CAST IRON SULPHUR STANDARDS,

The Iron Trade Review, December 3. Mr. W. G. Ireland gives a valuable contribution in connection with the sulphur standards for cast iron. The article is given in full herewith as it is of great importance to our iron chemists.

"The determination of sulphur in cast iron and pig iron is giving the chemists more trouble than all the other determinations they have to deal with. The method commonly used in daily practice is the evolution method, the evolving of the hydrogen sulphide into an absorbent and titrating with standard iodine solution. The iodine solution is standardized with standard borings in which the percentage of sulphur has been determined gravimetrically.

"If the standard borings do not evolve the percentage of sulphur as found gravimetrically, the standardization of the iodine is incorrect. Some chemists use a steel sulphur standard and some a cast iron or pig iron standard. It is claimed that in cast and pig irons all the sulphur is not evolved as hydrogen sulphide and when samples are worked against a steel sulphur standard, results will be low.

"Mr. W. E. Dickson, Sharpesville, Pa., in an article in *The Iron Trade Review* of June 18, 1903, showed the cast and pig iron standards to be unreliable after a short time, as they would not evolve the same amount of hydrogen sulphide as when first prepared and standardized. In this respect I fully agree with him.

"On June 1, 1903, I prepared a cast iron standard by breaking up all coarse borings in a mortar and passed them through a 20-

mesh sieve and over a 60-mesh. This gave me borings free from dust and separated graphite and of a very uniform grain. Samples were sent to several chemists whose results agreed very closely to .170 sulphur. I had a steel sulphur standard of .100 sulphur and made a great many determinations volumetrically on the cast iron standard, using the steel standard to standardize the iodine solution. All results were very close to .170 sulphur, allowing a few points for variation in work. Since that time I have used the steel standard to standardize iodine solutions, as its sulphur value of .100 was equal to the sulphur value in the cast iron .170. I have from time to time, worked the cast iron by the evolution method against this steel standard and obtained the following results:

From June 12 to August 12, sulphur .170
From June 12 to August 20, sulphur .160
From June 12 to August 26, sulphur .160
From June 12 to August 27, sulphur .159
From June 12 to August 29, sulphur .157
From June 12 to September 24, sulphur .152
From June 12 to October 14, sulphur .150
From June 12 to November 17, sulphur .147

"It will be seen that there was a gradual decrease after two months in the sulphur obtained volumetrically which if used as a standard of .170 would give a high iodine factor and high results. I then tried annealing the borings by heating them to a dull red in a covered porcelain crucible for 15 minutes with the following results:

	Evolution Method.		Oxidation Method.
	Sample not annealed.	Sample annealed.	Not annealed.
Oct. 16, 1903	.150	.160—.171	
Nov. 17, 1903	.147	.171	.172

"This plainly shows that while my cast iron standard was useless before annealing, after annealing it was all right, as I obtained results volumetrically which compared with gravimetric determinations.

"The American Foundrymen's Association send out standards showing percent of sulphur by the evolution method and percent of sulphur by the oxidation method Their standard "B" shows .038 sulphur by the evolution method and .056 sulphur by the oxidation method. I obtained some of this standard, also some sulphur

standard prepared and used by a Chicago chemist, which I will mark "X." Results in those two standards vulumetrically were as follows:

	American Foundrymen's Ass'n Standard "B."	Standard "X."
Official analysis reported	.036 sulphur evolution .056 " oxidation	.136 sulphur oxidation.
Without annealing	.038 .039	.130 .130
Annealing 15 minutes	.057 .059	.134 .135

Duplicate results were by two chemists.

"This I think proves that cast iron standards are not to be relied on unless annealed before using, and that there is not a "loss of sulphur in borings of pig or cast iron" as stated by Mr. W. E. Dickson, but that it is changed to some organic compound which is either not absorbed by the alkali solution or does not react with the iodine in the titration. This condition is overcome by annealing the borings before using, as you will then get results by the evolution method which compare very closely with results by the oxidation method.

"All volumetric results given were worked against a steel standard, which I standardized volumetrically against a cast iron standard, immediately after cast iron borings were taken from the standard bar, prepared and standardized gravimetrically.

"Results from a steel standard prepared in this way are equal to results when using a cast iron standard, and I think preferable, as steel will always evolve the same sulphur value, while cast iron will slowly change, as I have tried to show."

INFLUENCE OF SILICON AND CARBON ON SULPHUR IN MELTING IRON.

Stahl und Eisen. Prof. Dr. F. Wuest, of Aix-la-Chapelle made a series of observations on the effect of silicon additions, and the carbon present, on the sulphur of a cast iron. The fact that silicon has a tendency to remove sulphur has been known some time, but just under what conditions this took place was still undetermined. It seems that silicon and sulphur unite to a sort of sub-sulphide of silicon, which is very volatile at high temperatures. Prof. Wuest proves the existence of this compound by a series of determinations which the chemist is advised to study specially in the article

in question. We all have made the observation that when running a hot melt that we are not bothered so much with the sulphur as we are when running cold. Evidently this sub-sulphide of silicon is formed and volatilizes before the sulphur is absorbed by the iron itself. The results of the experiments thus made were that some sulphur will combine with silicon and volatilize under given conditions, but carbon does not act directly on the sulphur present to remove it.

DESULPHURIZATION IN THE CUPOLA BY MANGANESE ORE.

Stahl und Eisen. Dr. Wuest has gone into this interesting subject very extensively during the last year, taking regular records of mixtures and results. As a consequence he can affirm that the addition of the ore of manganese in the cupola in commercial quantities, that is some 4 per cent. of the charge, does keep down the sulphur to limits which makes the product quite good on that score. The original investigations were made by Mr. P. Reusch, of Muelheim.

THE CUPOLA FORE-HEARTH.

Stahl und Eisen. Dr. Wuest recently made a series of experiments to learn whether the forehearth of cupolas, as they are constructed in Europe, acted favorably or otherwise as a mixer of the melting charges. A series of tests were made side by side on cupolas with and without the forehearth, and test bars cast from each tap, analyses also being made to note the degree of mixing the pretty varied charges underwent. Each mixture contained a lot of steel scrap. The results showed very plainly that while very little effect could be noted on the sulphur distribution, that on the carbon was quite important. The fact that the iron in the cupola with the forehearth could not remain in contact with the fuel for any length of time, meant that the steel in the mixture could not take up much carbon. Therefore the resulting total carbon was lower than in the case of the ordinary cupola. This point is important to us here. We have no cupolas with a forehearth, but we do melt a lot of iron with steel scrap. Now where this is done

very extensively, the application of a forehearth and proper methods to keep the iron hot in it might be looked into more, and perhaps value received.

MANGANESE ORE AS A DESULPHURIZING AGENT IN THE FOUNDRY.

Iron Age, November 19, 1903. Joseph Wangler writes on the above subject giving tables and various data showing the reduction of sulphur in cupola practice by the use of manganese ore.

"The use of limestone in the cupola is necessary not only for the purpose of neutralizing a portion of the sulphur contained in the coke but also to carry off as slag the sand adhering to the pig iron. The sulphur in the product is reduced to a certain extent by means of limestone as a flux, depending upon the amount used. Under normal conditions from twenty percent to forty percent is taken up by the iron which may be reduced to fourteen percent by the addition of limestone. The lime in the slag should not exceed twenty-eight to thirty percent and the silica should be at least forty-three to forty-five percent. If these figures are exceeded it is almost impossible to work unless the blast is heated. A large body of slag is favorable to desulphurization as the amount of sulphur which can be taken up is very limited." H. C. L.

THE MANUFACTURE AND USES OF CARBORUNDUM.

F. A. J. Fitzgerald read a paper before the Philadelphia Foundrymen's Association, October 7th, 1903, giving the origin, present methods of manufacture and use of carborundum.

"Carborundum is a compound of carbon and silicon, consisting of carbon 29.70 per cent., and silicon 70.30 per cent. It is made by treating in the electric furnace in the proper proportion a mixture of sand, coke and sawdust.

"In the actual manufacture of carborundum the silica is supplied by means of a very pure glass sand made from crushed quartz. Carbon is supplied by coke which is as pure as can be obtained. The sawdust is used to make the mixture porous to permit the ready escape of gas.

"The most important use of carborundum is as an abra-

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sive for which purpose it is employed in various forms such as powders, wheels, papers, etc. In making up carborundum wheels various materials are used as a bond, viz., porcelain, shellac and rubber, but except for some special purpose the first named is used for a large majority of wheels.

"The safety of abrasive wheels is a very serious subject and one to which it will be worth while to devote a little time. Prof. Grubler, of Dresden, made a series of tests of abrasive wheels. About 60 wheels, including about all the well known kinds were tested and the results showed that all the tests were safe if properly used.

"Carborundum has been used in the manufacture of steel and cupola practice for the purpose of supplying silicon to steel or iron. Carborundum as supplied for this purpose contains about 62 per cent. silicon, 35 per cent. carbon, 3 per cent. iron and aluminum. In the case of steel it is added in the form of powder to the ladle. In cupola practice carborundum as a rule cannot be used in the ladle as the temperature of the molten metal is not sufficiently high, but instead it is mixed with the charge." H. C. L.

HEARTH AREA AND THE NUMBER OF TUYERES IN IRON BLAST FURNACE PRACTICE.

F. L. Grammer read a paper at the New York meeting of the American Institute of Mining Engineers which is interesting to foundrymen from the fact that it shows the variation in the quality of pig iron due to the shape, size and other conditions of the blast furnace.

"The rapid advances on the mechanical side of blast furnace practice have not always been accompanied by the proper appreciation of the metallurgical requirements. The one hundred foot blast furnace has not always been advantageous and in many instances the increase in the number of tuyeres from eight to twenty has resulted in decreased output. The metallurgists of the present generation experimented with the number of tuyeres used but no one has had the termity to place them in more than one horizontal plane in the last ten years. The number of tuyeres required in an iron blast furnace must be determined from the hearth diameter, the fuel and ore used and the grade of metal desired.

"As far as assisting blast pressure is concerned with a hearth

of the same diameter much relief in reducing the pressure cannot be expected beyond the use of eight tuyeres. The pressure necessary to overcome the resistance will be greater in proportion to the number of tuyeres.

"In determining the size of the hearth it is obvious that the character of the fuel must be taken into consideration. A fuel with cellular structure will burn more rapidly than one more dense. Coke having a cellular space of forty-five cubic inches compared with charcoal having one hundred and fifty cubic inches space in the same volume requires a different dimension for hearth area. A hearth of small diameter means that the combustion zone extends to a greater heighth in the furnace than if the hearth were wide and receiving the same volume of wind. It means also that the heat is somewhat more intense. This explains in some measure the fact that the silicon content of pig iron is usually higher with furnaces having a narrow crucible than with those having a wide crucible, In the former the dripping slag and metal remain longer in contact with the incandescent coke before reaching the bottom of the crucible; and a part of the coke is at a higher temperature than is usual with a furnace having a wider hearth. If small hearths tend to make high silicon iron, large hearths tend to make low silicon iron. In other words an increase in the number of tuyeres tends to lower the silicon in the pig iron produced in the furnace.

"It is known also that at higher temperatures iron dissolves more carbon, that is, makes richer iron, and other conditions being equal the iron will contain more silicon. Thus in order to increase the percentage of carbon and silicon in the iron produced the temperature of the furnace must be increased, which is accomplished by using less ore and a more siliceous slag." H. C. L.

POWDERED COAL FOR FUEL.

The Engineering Record, September 19, has an editorial on this subject, which while primarily intended for owners of power plants will be of interest to founders also from the metallurgical side of the question. Experience has shown that to use powdered coal to advantage, the material must first be dried and then burned with the exact amount of air required for complete combustion. Under such conditions it is economical. A good mill, using 25 HP will pul-

verize 4 tons of coal per hour. The coal dust should pass through an 80-mesh sieve. On the basis of a 40-ton plant the actual cost of drying and pulverizing coal was 32c. per ton. However, as a general proposition, with such a plant, and coal at $2.00 a ton, the fuel bill will be cut 40 per cent. The total cost of the plant for this purpose is $7,000. The drawback to the proposition is the difficulty of getting fire brick to stand up against the flame produced in this process. Only a wall coated with carborundum dust seems to stand up against it with good results. Then, finally, powdered coal is highly explosive and only as much of it as is actually needed should be made at one time.

"THERMIT" FOR MAKING SOUND CASTINGS.

The Iron Age, September 10. Mr. J. B. Nau, of New York, discusses the recent article of W. Matheson, in *Stahl und Eesen*, in which he advocates the use of "thermit" for making sound castings. This material is a mixture of powdered aluminum and iron or any other oxide, which when ignited, say at one corner of the charge, developes a high temperature, reduces the oxides in the mixture to the metallic state, and makes an artificial corundum of the aluminum which forms its oxide. The mixture burns without requiring any air or gas, and causes no gas. Now for the foundryman, the claim that the high temperature and the strong agitation produced in a bath into which this "thermit" has been introduced, is of the only interest. It is further contended that in the cupola the different metals introduced in the charges melt at different times, which is right enough; and that they run into the ladle separately and stay separate, the pouring from the spout downward not being sufficient to mix the metals, which is not altogether acceptable. Mr. Nau also holds that this is not the case and states that a liquid of a given density falling into more of the same liquid, does mix fairly well. Mr. Matheson mixes titanium oxide with the iron oxide and powdered aluminum for the "thermit" to be used in the foundry, finding that this is valuable. Mr. Nau agrees with him but claims very properly that the beneficial action is entirely one of purification, and hence an increase in the strength. A number of examples are given to prove this.

INSTRUCTION IN FOUNDRY CHEMISTRY.

By HERBERT E. FIELD.

PART 2.

(a) *General effect of impurities on "Properties of Cast Iron" and "Structure and Composition of Cast Iron." (See part 1.)*

(b) *Carbon.*

Definitions.

Annealing or Temper Carbon.—This is an amorphous, finely divided form of carbon which separates from white iron in the solid condition when subjected to prolonged heating as in malleable iron.

Graphitic Carbon.—This is a form of carbon which separates from cast iron while the iron is still in a molten condition and while it is still solidifying. It generally has a crystaline appearance.

Crystaline.—A substance is said to be crystaline when it is bounded by plain surfaces symetrically arranged.

Amorphous.—A substance is said to be amorphous when its particles have no regular shape.

Grain.—As spoken of in regard to cast iron this means a combination of crystaline or irregularly shaped particles which when joined together form a surface. It is spoken of as fine grain, coarse grain, etc.

Contraction.—When used in connection with cast iron, this means the decrease in size due to a lowering of temperature.

Shrinkage.—When applied to cast iron this term is generally confused with "contraction." It is used to describe the pulling or drawing away from the liquid or plastic portion of cast iron due to the contraction of some part of the casting which has already solidified. The cavity thus left is called in foundry parlance, a 'shrink.'

In Review.

In the first part we learned under the heading of "Structure and Composition of Iron" that cast iron was cast iron because of

the impurities that it contained. Under "Properties of Cast Iron" we found that there were four properties which made cast iron valuable. First, its fluidity; second, its low shrinkage; third, its softness, and fourth, its strength. We concluded that the impurities which gave these various properties to cast iron must be very important parts of the cast iron.

ELEMENTS CONTROLLING THE PROPERTIES OF CAST IRON.

Elements giving fluidity.

The elements or impurities which give fluidity to cast iron are carbon, silicon and phosphorus.

Elements giving low shrinkage.

The elements which give low shrinkage to cast iron are carbon, by its direct action, and silicon and phosphorus by their action on the carbon or by their action on the iron and through it on the carbon.

Elements giving softness.

The elements which give softness to cast iron are graphitic carbon, by its direct action on the iron, silicon by its action in forming graphitic carbon, phosphorus by its action in keeping the iron hot, and giving more time for the graphitic carbon to separate and manganese in certain instances by neutralizing the hardening effect of the sulphur.

Elements giving strength.

The elements which give strength to cast iron are combined carbon, up to certain percentages, by its direct action on the iron, manganese, by its action on the carbon and sulphur, and sulphur if added to very weak, soft iron.

ELEMENTS NECESSARY TO DIFFERENT DIVISIONS OF GREY IRON.

Stove Plate Grades.

In Part 1 we observed that fluidity was the most desirable property for stove plate grades, and that softness was next in importance. From what has just been observed we can readily see that stove plate and like grades of iron must be high in silicon and phosphorus, as these will give fluidity and softness.

Light Machinery Grades.

For the light machinery grades we observed in our first paper that while fluidity and softness were very desirable properties, they

could not be considered to the exclusion of shrinkage and strength, for these latter are the more important factors in these grades. Hence in this division the phosphorus and silicon must be somewhat lower and the carbon and manganese a little higher. The former to reduce the shrinkage and the latter to add strength.

Heavy Machinery Grades.

In this grade we noted that fluidity was no longer such an important feature and that the iron on account of the cost of machining should be as soft as possible and yet be strong enough for the work in which it is used. Low shrinkage is also a very important item in heavy machinery. We must therefore reduce our phosphorus and silicon and increase our carbon and manganese in order to keep the iron soft and the shrinkage low.

High Strength Grades.

In Part 1 we noted that in this grade the shrinkage must be taken care of in the designing and that the casting should be as soft as possible and still be sufficiently strong in order to keep down the cost of machining which is apt to be high on such work. In order to do this therefore, we will have to increase the manganese and decrease our phosphorus, silicon and carbon.

Effect of Individual Elements on Cast Iron.

1. CARBON.

General Effect on Cast Iron.

The element carbon forms a very important part of cast iron. In fact, it is absolutely necessary that cast iron contain carbon, for without it we would have a substance which would resemble wrought iron with its high shrinkage, lack of fluidity, and high melting point. The carbon mixed with the iron gives it that property which makes cast iron so valuable, namely, its low shrinkage. It reduces its melting point and adds to its softness and fluidity. In the majority of uses to which cast iron is put, carbon acts as the medium through which the other elements work.

Percentage of Carbon in Cast Iron.

The percentage of carbon in cast iron varies from 2 to 4½ per cent. The average carbon in cast iron is probably about 3.40 per cent. The per cent. of carbon in high silicon pig iron, with silicon 8 to 10 per cent., runs down to 2 per cent., while some castings

for especially strong, heavy work, made in an air furnace, also have a very low carbon. Bessemer iron, on the other hand, often runs up to 4½ per cent. in carbon, as do some charcoal irons, while an occasional coke iron runs over 4 per cent., but the majority of such run between 3 and 4 per cent. Many of the books and papers on cast iron assert that the variation in carbon in ordinary iron is not sufficient to cause any difference in the quality of the iron. Such is not the case however. Other elements and conditions being the same, the higher the total carbon in the iron, the softer will the castings be. An increase of .25 per cent. in the total carbon exerts a notable increase in the softness and a decrease in the shrinkage and strength of the iron.

Condition of Carbon in Cast Iron.

There are four kinds of carbon in cast iron. In general consideration, however, these four are included under two divisions—Graphitic Carbon and Combined Carbon. Graphitic carbon may be divided into temper carbon and graphite, while combined carbon includes carbide carbon and hardening carbon. Temper carbon, or annealing carbon, is the form of carbon found in malleable iron after annealing. Graphitic carbon is that form found in soft cast iron. Carbide carbon is the carbon contained in a true compound of carbon and iron. It occurs to a greater or lesser degree in all cast iron. Chilled iron, however, contains a considerable portion of its carbon in this form. Hardening carbon is that form of carbon which makes our castings hard. All cast iron contains some hardening carbon. The harder the iron the greater the percentage of carbon present. For the present in our study, we will confine our study to the two divisions—graphitic carbon, and combined carbon.

Graphitic Carbon.

Graphitic carbon exerts a softening influence on cast iron. It reduces shrinkage, frequently gives to the iron an open crystaline appearance, especially in large sections, and decreases the strength if present in the crystaline form of graphite.

Combined Carbon.

Combined carbon hardens cast iron, increases the shrinkage, gives a close grain to the iron, lowers the melting point, and increases the strength when present up to a certain percentage.

Relation of Graphitic to Combined Carbon.

The difference in the grade of cast iron is marked by the in-

crease or decrease in the proportion of the combined to the graphitic carbon. The so-called very soft irons contain as low as .1 of 1 per cent. of combined carbon, while the other 3.40 or 3.50 per cent. is free or graphitic carbon. As the grades grow harder the combined carbon increases, and ordinary soft iron contains from .2 to .5 of 1 per cent. of combined carbon, while the harder castings run up to .6 of 1 per cent. Strong iron castings generally contain .45 to .9 per cent. of combined carbon. The proportion of combined carbon continues to increase as we go through the harder grades of cast iron until we reach the chilled iron grade. In the chilled part all of the carbon is in the combined condition.

Factors Controlling the Condition of Carbon.

We have noted the different forms of carbon and their effect on cast iron. A few words in regard to the reason for these conditions is necessary at this point of our study although a more thorough discussion will be given in a later paper. There are four factors which determine the proportion of the combined to the graphitic carbon in cast iron. First, the total amount of carbon present; second, the rate at which the iron cools; third, the temperature of the iron when it begins to cool; fourth, the amount and kind of the other elements present in the iron.

Condition of Carbon Controlled by Amount of Carbon Present.

The greater the amount of carbon present in the iron, other elements being the same, the greater will be the proportion of the graphitic to the combined carbon. For example, an iron with 4 per cent. Total Carbon would have a greater proportion of graphite than an iron having 3 per cent. Total Carbon if both contained the same amount of other elements, were cast from the same temperature, and were poured into the same sized sections.

Condition of Carbon Controlled by Rate of Cooling.

The rate at which an iron cools has a very important influence upon the proportion of the combined to the graphitic carbon. The more rapidly an iron is cooled, the greater will be the amount of the combined carbon present, and conversely, the slower it is cooled the greater will be the amount of graphitic or free carbon present. This is illustrated very clearly in chilled iron work. In this work, the part next to the chilling surface may have all its carbon in the combined form, while the part away from the chilled surface may

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have but a small proportion of its carbon in the combined condition. For example, if an iron containing 3 per cent. of carbon be cast against a chill and the mass of the metal be sufficient to allow the rest of the iron to cool slowly, the part next the chill might contain 3 per cent. of combined carbon and no graphite, while the part away from the chill might contain but 1 per cent. of combined carbon and the other 2 per cent. be graphite. The part next the chill is chilled very rapidly; the heat being taken away from the iron so quickly that the carbon remains in the combined condition. The part away from the chill cools more slowly, and allows more time for the carbon to separate as graphite. The effect of sudden cooling upon the carbon may be clearly shown by dropping small particles of molten iron into water and casting some of the iron out of the same ladle in a dry sand mould. The former will frequently be white and hard and have all its carbon in the combined condition, while the latter will be grey and soft and have nearly all of its carbon in the graphitic form. If a cast iron roll chilled on the outside by casting it in a heavy iron chill be broken so as to show the round section of the roll, and then a series of holes be drilled in a straight line from the outside to the center and the chips from each one of these holes be analyzed separately, we would find that as we went from the outside to the center, the combined carbon would gradually decrease and the graphitic carbon would increase. We know that iron sets first on the outside of the roll and that the center of the roll remains hot the longest and as our combined carbon was greatest on the outside, we have an illustration in one casting proving that the more rapidly the iron is cooled the greater will be the proportion of the combined to the graphitic carbon.

Condition of Carbon controlled by the Temperature.

In the previous paragraph we have noted that the slower an iron cools the greater will be the proportion of the graphite. It is very clear then that the higher the temperature of the iron when it begins to cool, the greater will be the time allowed for the cooling and hence the greater the proportion of the graphite.

Condition of the Carbon controlled by Other Impurities.

The kind and amount of other impurities present effect the condition of the carbon in the iron. These will be considered more fully in later papers under the head of the several elements. In brief, however, silicon increases the graphite and decreases the

combined carbon. The greater the amount of silicon present the greater will be the amount of graphite until all the carbon is in the free form. Sulphur increases the combined carbon, the greater the amount of sulphur present, the greater will be the amount of the combined carbon. Manganese in its direct action on carbon increases the proportion of combined carbon. Phosphorus probably has no direct effect upon the carbon, other than that it prolongs the cooling of the iron thus giving more time for the separation of the graphite, and thus decreasing the combined carbon.

We have given a considerable space to this discussion of the proportion of the combined to the graphitic carbon because it is this ratio which largely determines the value of an iron for a given work. It is very necessary that this subject be thoroughly studied before the following papers can be properly understood.

A PROBLEM IN THE METALLURGY OF CAST IRON.

The Iron and Steel Metallurgist, January, has an article from the pen of Dr. R. Moldenke, which ventilates an important subject.

Considerable attention has of late been directed to the study of cast iron from the metallurgical standpoint, and we come across problems herein which are far more complex than those met with in the closely related steel casting. It is only in the physical manipulation of the latter in the foundry that special attention must be paid, the higher temperature, and absence of mechanically mixed graphite limiting appliances, methods, and materials to a very few high class steel castings, whereas ordinary iron castings are produced under a variety of conditions.

The chemical properties of cast iron are such that failure to meet specific requirements may occur at any time. We have to deal with comparatively high amounts of impurities, any one of which in similar quantity would unfit a steel for service, as a regular feature of the industry. Even the carbon present may be in the shape of graphite, mechanically mixed, temper carbon, one of several forms of combined carbon, or all of them together.

The art of founding has now been studied from its metallurgical side sufficiently to allow us to make a mixture with the reasonable assurance that the requirements will be met (the molding conditions, as we may term them, being presupposedly correct)barring

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only two factors. These two factors are the absorption of sulphur from the fuel, and the retention of the oxide originally in the metal charged or else introduced subsequently as part of the melting process.

On the sulphur question this much can be said: By the purchase of irons and coke comparatively low in sulphur much of this trouble can be avoided, indeed even with sulphur present in considerable quantities in the coke, the use of sufficient fuel to make very hot iron drives off sulphur before it can combine with the melted metal. Then again by adding some ferro-manganese to the ladle, or better still using a high manganese pig in the mixture, some of the sulphur may be slagged off. Possibly, however, the addition of a manganese ore with the flux promises the best results, the recent European experiments along this line justifying a closer study of the method. Here also it must be remembered that only the plentiful use of fuel will give favorable conditions to effect a removal of the sulphur.

The greatest and perhaps least realized difficulty the foundry industry has to contend with, is the presence of dissolved oxide of iron in the pig and scrap used for the production of castings requiring exceptional ability to withstand severe and rough service. Take for instance the chilled roll, with the enormous strains, both from the metal pressed and the internal heat variables, to be overcome without injury; the heavy, rough and intermittent service required of it, and the damage and delay when it breaks. Again, look at the production of the roll casting in the first place. Enormous molecular tension exists as the mass slowly cools. It is little wonder that many rolls crack before they are cold, and still more of them must be thrown out for defects laid bare upon turning them up.

In this industry we note that the founder takes the natural method of overcoming these difficulties by buying only the very best of irons, which does not mean the purest by any means, but those irons which his experience has shown him to be able to resist the casting strain successfully, as against others with the same composition which do not. We find the same thing holding true for the car wheel, the malleable casting, and a number of other branches of the foundry industry where physical strength must be combined with a given composition.

Now what is the reason that the crystals of one iron adhere to each other so much more tenaciously than those of another of ex-

actly the same composition and made under the same heat conditions? A wide experience with the open hearth and the reverberatory furnace for cast iron leads me to conclude that this is due only to the greater or less freedom of the iron from dissolved oxide. Even the most unenlightened founder when judging the probable strength of an iron from its freshly fractured surface will pass his hand over it to note whether the particles have been roughly torn apart or whether they have simply separated from each other along crystal planes. In the former case the iron must have been tough and hard to separate, and in the latter it was weak and unable to withstand shock.

It is for this reason that I proposed some time ago to test pig iron by remelting under standard conditions, casting standard test bars, and subjecting these to physical tests, a given composition thus showing the quality of the iron tested when compared with others of the same composition for just such important work as rolls, car wheels, malleables, gun metal, and furnace or cupola iron in general which must be up to and if possible beyond the high water mark for cast iron. The time, however, does not seem ripe for this, and so we must turn to other methods of overcoming this difficulty which is more marked in the low silicon irons than in those used for the softer castings.

Judging from steel practice we would at once turn to ferro-manganese for the removal of oxide from the bath. Prof. Ledebur showed the effect of this addition very nicely by determinations of the oxygen present before the addition of the metal, and right after it. This illustrates the entire removal effected. Then there was a gradual accumulation of more oxygen in spite of the manganese present, followed with a second addition of ferro-manganese. When the steel was tapped its freedom from dissolved oxide was shown. Now this looks very nice for steel, but unfortunately cast iron when in the molten state is not so hot, so that the reactions with manganese do not take place so far as the oxygen is concerned, and therefore some other method must be used.

Aluminium is the next element which appeals to us. In the high silicon irons there is no objection to its use, in fact it immediately absorbs the gases present and quiets the metal if it should be troubled. But for the low silicon irons aluminium cannot be used, unless in the smallest quantities, as it promotes the formation

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of graphite, which is fatal to much of the work for which these irons are used.

The last candidate for favor is titanium, in an iron alloy. From experiments made by Mr. Rossi in my foundry, I am inclined to think very favorably of its use as a purifier of the metal from just this oxidation, at least to a considerable extent. The addition of some 0.2 per cent of titanium to the metal, all of which was oxidized away, left the metal about 20 per cent stronger, yet with no change in the composition as a result of this addition. This would seem to indicate something of value. I rather think that other elements will be found to act similarly, and suggest that experiments be conducted to this end.

If we can ever arrive at a method which will correct the injurious effects of poor blast-furnace practice, poor melting in the foundry, in fact restore a bath of iron to its purity, if this word may be used, so that when cast, the metal of a stated composition may have a corresponding strength, as is the case in open-hearth steel, where the making of given carbon steels for required physical tests is a matter of daily practice—if we ever reach that point, a gigantic stride will have been made in the metallurgy of cast iron.

I therefore throw out this suggestion to our investigators, asking them to work along the lines indicated, to give the foundry industry the means of saving metal and thus working closer to the requirements of the age in conserving the resourses of iron industry.

FOUNDRY MANAGEMENT

Edited by JAS. A. MURPHY, 114 W. 20th St., Erie, Pa.

Questions, comment an l criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Murphy

"COLD SHORT" SASH WEIGHT AND BRAKE SHOE "INVENTIONS."

The sash weight seems to have been given a good long rest by the many inventors who were continually trying to revolutionize its manufacture. It had a good run in permanent chills until property owners discovered that these innocent looking castings were sawing oblong holes into the sides of the buildings, to spite the architect who strove to effectually conceal them. Evidently the fins could not be chipped off, and when broken gave the side of the weights an appearance of the much abused hack saw.

But the time honored brake shoe is still doing a vigorous business at the old stand, and making many dollars honestly and otherwise through the efforts of various inventors. We remember a recent New Jersey company which was going to turn them out by the million from a chill mold; which chill mold must have met a chill, as we have heard nothing subsequently of its revolutionizing effects on the trade.

If we credited everything we saw in print on the wonderful reduction in the cost of making these universally used articles, we would soon arrive at the point when they could be made for nothing.

The latest in the brake shoe field is that of a Mr. Sargent, in Chicago, who instead of gating them at the end as is ordinarily done, runs the iron into one of them, and the others off of this. The first one acts as a basin and dirt catcher, but that does not probably matter, as possibly rail roads do not want clean brake shoes in that part of the country. The saving comes in the reduction of the size of the flask two inches one way. We fail to see the logic of putting more gates and fins at the sides, increasing the labor of finishing, in order to save a few strokes of the rammer for the molder whose time is not worth much more than that of the laborer. Or if made on the machine, why increase the danger of dropping out when taking away the drag half?

We have seen brake shoes and several other things run that

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way, especially when the boss was not around. This process is in its finest state of perfection where the molder works by the piece. They crowd every piece that they can get into the flask, to get the price, often not leaving room enough to gate the ordinary way. They use the least important casting as a gate, and run the others from it. We have seen as many as thirty different pieces, all together weighing about 600 pounds run this way. It is known as the "dead head" system in the shops where it prevails. Some pieces even have two prices set on them; a regular price when made alone, and a "dead head" price when in combination with other things.

We know of several shops where it would be a strenuous job to collect royalty on Mr. Sargent's invention. In the meantime we are waiting for the man who will feed old stove plate and tin cans into one end of his contraption and emit finished sash weights and brake shoes at the other.

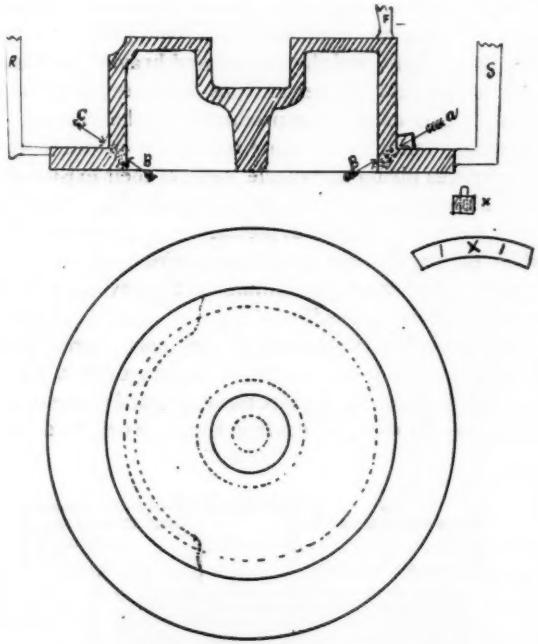
"HOW THEY DO IT IN MANCHESTER."

This is the title of an article on cupola management, in the September *Foundry*, from the pen of John Swain. We rather think it no record to boast of to have three laborers with two bosses over them charge 50 tons in a day with all the modern appliances at their command, even including a weighing machine. We would also like to hear how Mr. Swain manages to melt 896 lbs. of iron with 96 lbs. of coke. Is this the far famed 16 to 1 running riot in English foundries? Has some of our campaign literature strayed over there and landed on fertile soil? We knew some people who imagined that they melted iron at ratios of 10 to 14 to 1, but they seem to have disappeared recently in spite of the demand for such geniuses. In fact with such a trick to command, there are several American foundries melting from 50 to 150 tons a day, which would be eager to put Mr. Swain up to how to evade the contract labor law, and make it an object for John to emigrate.

A CYLINDER HEAD PROBLEM.

We have recieved a number of inquiries during the last few months on the subject of bad and spongy cylinder heads. Some of those interested asked for a mixture on chemical lines to overcome

the leaking of steam at the points A B C D, shown in the accompanying cut. Most of the castings were made as shown, some putting a riser at F, while others put one or more risers on the flange S.



We need not go into the why and wherefore that these risers do not give the desired solidity, but will simply say that they are not worth the trouble of putting on; neither will a fillet, large or small, prevent the segregation at the indicated point. If our correspondents will use a chill X on the outside as at A, their troubles will disappear.

For small cylinders the chill may be made in one piece, but for large ones it is best made in sections. The chill when tied to the cope will make the best kind of a gagger.

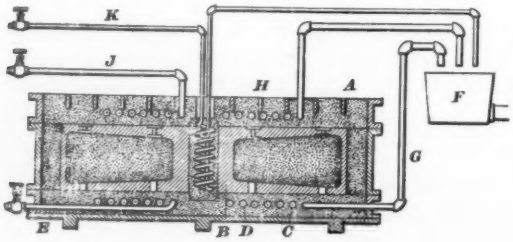
THE PLUMBER IN THE FOUNDRY.

Mr. W. A. Bole, general superintendent of the Westinghouse

Machine Co., of Pittsburg, has presented an interesting plan for ensuring the absence of many of the cooling and shrinkage strains in castings, says the *Iron Trade Review.*

"In making castings with unequal thicknesses of metal, particularly if the castings are of large size, some portions will cool more rapidly than others, and the thicker and heavier sections continue to contract after the thinner sections have assumed their final dimensions. Strains are thus produced in the castings which are sometimes so serious as to cause rupture, even while in the mold, and sometimes giving no visible signs of their existence until the skin of the castings is removed by machining, when the internal stresses produce a rupture of the casting. Cases have been known in which the rupture due to internal strains took place months after the castings were made and without any previous indication of the existence of these strains."

All of this is very true and to the point, provided the design cannot be corrected, or the metal be improved in quality. The piston shown is not, in the first place, molded in the most approved manner, and the designer could get up a more rigid construction,



showing less unevenness in thickness and more strength. It would seem to us that there are grave dangers attending this manner of molding, unless the greatest precautions are taken to have everything tight.

It would also seem that such costly methods which are also dangerous in the hands of the wrong men, should be avoided in the foundry, especially as the already overworked foreman cannot give it the attention it must have to be safe.

The device is nevertheless interesting from the standpoint of

what can be done in the foundry to attain given results. The ordinary foundryman must be content to get along with the usual ways to get good castings, and to him this method cannot be recommended, good as it is for what is sought.

INCOMBUSTIBLE ROOFS.

Insurance Engineering, November, describes the features of the new foundry of the Brown & Sharpe Mfg. Co., which appeal specially to the Insurance Expert The whole plant was constructed with protection from fire hazard in view. The buildings are nearly altogether of steel and glass, in fact the walls are almost entirely of glass, but little brick-work being between. Cinder concrete floors are the rule throughout, and the roofs are so designed that water and snow may be gotten rid of rapidly. Hot air is used for heating, the volume being directed from one point in the side of the building, thus doing away with sheet metal piping. The south side of the roofs are sheeted with copper, and the valleys are of asphalt.

On the whole the structure is fire-proof wherever possible, and at least slow-burning where wood construction had to be used.

CASTING PITS.

Mr. Walter J. May, in the *Mechanical World*, gives some good hints about putting in casting pits in wet foundry floors. To those who persist in the custom of building foundries in swamps, the following is respectfully dedicated:

"Probably well-puddled, adhesive clay will resist water as well as anything, and 1 foot in thickness of well-tempered clay, put together so as to be free from cracks and fissures, should be ample. Overlying this, from 1 foot to 18 inches of good cement concrete should be placed. The walls should be built on the concrete, and, in accordance with the size of the pit, be from 9 to 14 inches in thickness, good, sound brick, set in cement and sand, and well grouted together, being used. The work being permanent, sound and good work of a lasting character should be adopted, and there should be no open joints. The top row of brick should be bull-nosed, on the inner edge at least. In placing the concrete for the floor, it should be so arranged that the backs of the walls from and

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continuous with the bottom layer of clay puddle be backed with 1 foot of puddle well put together, and when this is done water will be excluded."

CORLISS CYLINDERS IN DRY SAND.

The Foundry for December has a well illustrated article on molding corliss cylinders in dry sand by Paul R. Ramp. He goes exhaustively into the subject and when he is ready to try on his cope, gives the following method of doing it. (The italics are ours.)

"A portion of flour is distributed over the joint of the drag and on the core prints that come in contact with the cope and the cope closed and *drawn down tight with clamps*. The clamps are then loosened again, the cope hoisted off and the dirt blown out of the mold. The mold is then carefully inspected to see if there is a crush anywhere as a result of an irregular or poorly made parting. When this has been accomplished, a thin roll of putty or clay is laid on the flag joint and over the prints of the cores to prevent a run-out, or the iron getting into the vents. The cope is then lowered on to the drag and securely clamped."

We have no hesitation in saying that this method of closing dry sand molds of any kind is open to grave objections, and the molder who would work in this manner would have a hard time under most foremen of our acquaintance. Clamps are not put on a mold to squeeze it together (dry sand molds will not squeeze, they crush) but to hold both parts from separating during pouring. It is then that the metal would lift the cope from the drag. A cope's own weight should carry it to its place, and a spot of flour here or there is sufficient to test its trueness. It it not even safe with the great majority of dry sand molds to clamp them after they are fairly closed without first patching the joints. If this is done there will be no dirt to blow out after trying the cope off it, the prints do not crush. Putty is good for a joint but is too expensive for ordinary use, hence dough rolled out between the hands is probably the most common. Clay is considered the worst, as it does not crush enough and makes a heavy fin as well as throwing the casting out of true.

THE NEW FOUNDRY AND PATTERN SHOP OF THE B. F. STURTEVANT CO.

Our good friends and members, the B. F. Sturtevant Co., have kindly sent us a number of cuts of their new foundry and pattern shop. We take this occasion to thank them for the courtesy shown, and feel certain that views of the establishment here presented, being of a strictly up-to-date character, will interest all foundrymen, irrespective of the line of work engaged.

Fig. 1 shows the ground plan of the foundry, giving us an

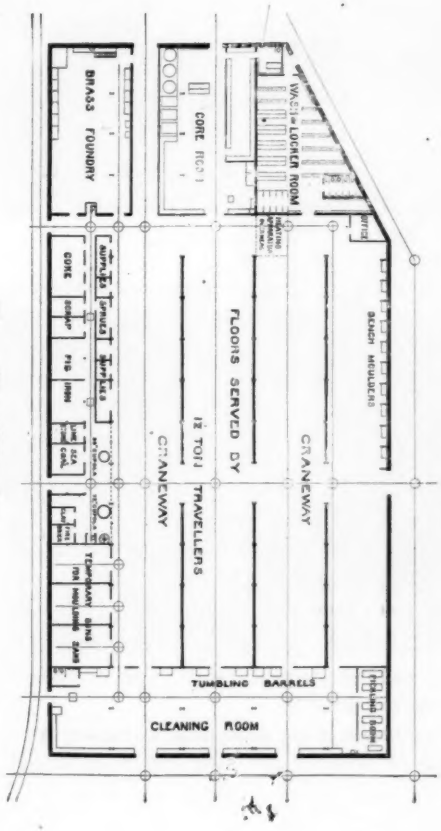

Fig. 1 Plan of Foundry

excellent idea of the transportation facilities provided. All this, including the track, turn-tables, cars, trucks, etc., were designed and made by the company. Figs. 2, 3, 4, and 5, show some of the various kinds of cars and ladles used, all being provided with a

Fig. 2 Platform car

Fig. 4 Dump car

Fig. 5 2-ton transfer ladle truck

Fig 3 Charging car

special type of ball-bearing practically devoid of machine work, but with chilled wearing surfaces.

We get a glimpse of the substantial crane-way for heavy work in Fig. 6, a 20-ton traveller covering the floor beneath. Fig. 7

shows a very neat floor for bench molders. This is of concrete and is served by a track system connected with the rest of the foundry.

Fig. 6 Crane way for heavy work

Fig. 7 Bench molders' floor

Fig. 8 shows a section of the foundry ready to pour. Note the fine light from the large window area. The core room, Fig. 9, is situat-

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ed in the middle of the end of the foundry. It has six ovens of large dimensions, some of them provided with cars, and served by an overhead traveller.

Fig. 8 Ready to pour

Fig. 9 Core room

The cleaning room is at the other end of the foundry, Fig. 10, and is well equipped with tumbling and cylinder barrels, air hoists and tools, etc. A very ingenious system takes care of the charg-

ing of the cupolas, the charging floor being shown in Fig. 11. The cars after unloading are pushed to an incline where they are let down automatically very carefully to the lower floor.

Fig. 10 Cleaning room

Fig. 11 Charging floor

Figs. 12 and 13 show the pattern shop and pattern storage. The former is 60 x 80, and the latter consists of two stories of the same extent each. Ample machinery is provided, and an excel-

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lent card system keeps track of the patterns. The shop is well lighted, being heated and ventilated by the Sturtevant system, a specially interesting feature of the plant being a tunnel system for all the pipes and wires.

Fig. 12 Pattern shop

Fig. 13 Pattern storage third floor

CASTING WITHOUT PATTERNS.

The October *Foundry* has an admirable article on making castings without patterns, by Henry Hess. This method is largely used by builders of large machine tools. While the method is admirably adapted to some particular work, it can, like other good things, be carried too far. It should always be borne in mind that cores and core-boxes are not got for nothing, and cores do not go together to form a mold of their own accord either.

FOUNDRY FORMULAE—A PLEA FOR MORE.

By JOHN F. BUCHANAN, Sidney, N. S. W.

If I may be allowed to define a formula as an abbreviated rule, the assertion that Foundry Formulæ are not so plentiful as they might be, should pass unchallenged by all who are in any way concerned with the gentle art of making castings. A formula is generally construed by foundrymen to mean a mixture, but I prefer to employ the term in its broadest sense. So-called trade secrets are nowhere so well guarded as in the foundry; and to this day, a brass-molder would eye you with suspicion if you asked him to disclose the composition of a certain casting. In some quarters, core sand, facing sand and blackwash mixtures are supposed to have pre-eminent virtues, and to suffer from indiscriminate manipulation; in others, the methods of estimating the weights and other physical attributes of castings, or the *modus operandi* of evolving prime costs, are regarded as vested interests.

Numerous beautifully lithographed systems of foundry accounting have been displayed, but few figures of any real significance have left their mark on the pages of foundry literature. I do not agree with those who think, if you wish to be informing on foundry matters, it is necessary to launch into slashing innuendoes on the obsolete methods practiced in some of the other shops.

The latent wisdom of all sorts and conditions of mechanics is never so near becoming prophetic as when one of them (not a molder) happens to visit a foundry in full blast. What suggestions come forth! How ingenious in discovering other ways of doing difficult things! Even the impossible is not hopelessly so, and the molder must be a numb-skull if he never thought of that before. Undoubtedly! Step up, O self-appointed superintendent of the

greasy countenance, or the saw-dusty garments, and rate the louts in good set terms, for their want of foresight and intelligence; dictate to them the only proper course, and relieve yourself of much of that technical garbage with which you are encumbered. The foundry, as viewed by this gentleman, is chaos vizualised:—a hideous dumping ground for dirt, debris, offal, and scraps, with never a bright spot on the horizon, unless it be the glowing ladle travelling from furnace to flask. Happily there are other views to be had. There is the view *superior*—from the eminence of the pattern-loft; the view *retrospective*—fron the gallery of the erecting shop, the view *refined*—from the seclusion of the testing room; and the view *continuous*—from the inside, where I am at present.

Rules are considered beneath the notice of the average molder; data is another word for 'dry rot', and a formula is a kind of meaningless cryptogram, generally affected by the man who wishes to pose as a foundry expert. Yet, although these are something like the opinions of the average molder, (and it must be conceded he has the habit of success in his work, without being over-burdened with the technical niceities) we must not blame *him* only, if we find he cannot see eye to eye with those who are seeking to marry Science to Industry, in his particular sphere of action. He is industrious even if he does lack prescience. He is wise enough to learn from his failures, for he has discovered that materials, as well as men, have their moods. He is an honest artisan who has pushed his way upwards by paying attention to the old adage, "try, try, try again."

Traditions die hard; and to anyone who has travelled round the foundries the traditions are numerous enough to secure attention, and venerable enough to gain respect. It is traditional that there are no rules for molding. Most of the operations involved in foundry practice have evaded classification, because one molder's method might prove another molder's madness. As, who should say to the *Maestro* freeing a *cire perdu* figure, 'that should have been cast in a chill,' or to the sash-weight molder, 'these blocks ought to be made in loam.' And he would be a bold craftsman, indeed, who would attempt to define the dividing line between castings suited for the green or the dry sand methods

Many a casting has been made by the wrong method, and, while in appearance it might pass for 'a thing of beauty,' when in position it would be anything but 'a joy forever.' Even where the

molding process is wisely chosen there are difficulties confronting the tradesman who is aiming at the highest handicraft. Seeing then that rules or formulæ, to be of any practical use in the foundry, must rest entirely on an experimental basis, it is not to be wondered at, if the few which have been permitted to see the light, and pass for standards, are rigid as to their application, and frigid as to their influence. Most of them have emanated from the laboratory or the drawing office, and the molder has not yet mastered his contempt for pure science or theoretical arithmetic. Nevertheless standards are necessary to adjust the balance for all the relations of life. We have moral, social and business standards, and every standard is a formula *in extenso*, a law, a rule by which our works are measured. We do not always get the reward we expect from adopting a high standard—and philosophy is a poor consoler in such a case. But there is no philosophy in business; there is activity, and the adoption of new standards when the old ones fail. Foundry standards in the shape of foundry formulæ are beginning to be a felt want. Long ago foundrymen were forced to recognise a standard of quality in their output; now the tables are turned and they are going to acquire a standard for the other end of the foundry—the stock yard. The Standardization of Cast Iron, which will soon be *un fait accompli*, is a noble achievement in the direction of establishing Foundry Formulæ.

The chemist has come into the foundry to stay, so has the foundry accountant, and bye and bye when we have accumulated sufficient data, the foundry formula-maker will just as surely arrive. Engineers are well equipped with rules, tables, formulæ, data, statistics and other dry-as-dust particulars and generalities relating to all the known bodies, principles and theorems in the universe. But who shall classify the reasons or results of molding procedure for us? He has his work cut out for him; to break up the new ground to introduce the new hypotheses, to announce the new ideas, to herald the millenium for molders. I can only suggest some of the subjects he will have to deal with, and some which it would be desirable for him to get interested in as soon as possible. It is probable that I shall omit to mention many forms of service pressing for the attention of the statistician, or the formuliser; but I hope the omissions may act as a stimulus. Rules are wanted for, the proportions of runners, the dimensions of chaplets, the height of risers, the content of heads, and the relative thickness of brass,

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steel and iron castings designed for the same purpose. None of these things have been graduated or reduced to anything like a formula. Again, tables of the atomic proportions of alloys would be useful to brass founders in spite of the fact that the mixing of alloys in atomic proportions has only been put to practical use in a few notable instances, as Rosse's speculum metal, or Parson's manganese bronze. The groupings of metals *by their affinities for each other*, as well as by their affinity for oxygen, would be instructive in the same quarter. Then, the casting temperature of metals (popularly known as the 'proper heat') could be fixed by color tests. The following table by Pouillet attempts to explain the temperatures corresponding to different colors, and recently it has been

Incipient	red	heat	corresponds to	525° C.
Dull	"	"	"	700° C.
Incipient	cherry	red	"	800° C.
Cherry		"	"	900° C.
Clear	cherry	"	"	1000° C.
Deep	orange		"	1100° C.
Clear	"		"	1200° C.
White			"	1300° C.
Bright	white		"	1400° C.
Dazzling	white		"	1500° C.

proposed to adopt color names for high temperatures. (See *Engineering and Mining Journal*, January 20th, 1900.) The atomic volume of metals has been proved to be an important factor in reducing friction; a table of atomic volumes would therefore show at a glance the metals best suited for anti-friction purposes. A table giving the heat units required to melt a given quantity (say 100 or 1,000 lbs.) of any of the metals, would convey some instruction and help the foundryman to follow in detail the economics of melting. The cost of melting cast iron in the cupola, is for all practical purposes, a constant quantity in most foundries, so that it should be just as easy for foundrymen to base their bids on the price of the molten cupola iron, as upon the raw material. They only require to fix on a constant which can be used as a multiplier for castings of any description irrespective of the labor and other expenses. In the same way, foundries doing special lines of castings can adopt constants to cover labor, material and profit, with the molten iron at a fixed price. Let me illustrate. I find

here that it takes nearly six shillings to produce one cwt. (112 lbs.) of cast iron for castings, running the cupola for a heat of not less than five tons. (The average price of pig iron in Sydney, N. S. W., is about eighty-five shillings per ton. This calculation includes metal, fuel, labor, power, waste and profit on capital.) By using 6 as a constant for molten iron, and finding other constants (graded to include open sand work, green sand work, cored and solid, dry sand work, and loam work) for the separate expenses incurred in molding and handling the castings; or if the work is uniform, by using an approximate figure for all the other items, I arrive at the ultimate cost, in shillings per cent. of castings in any class. This example is not given because of any inherent advantages; it has neither originality nor unfailing accuracy to recommend it, but it may serve to illustrate the empirical methods of deriving foundry formulæ at present in favor. Foundrymen are hampered with too many empirical rules. The 'charge' is an elastic term for a quantity of coke and iron in the cupola. "Weighting down," (*i. e.*, the placing of sufficient weight on the surface of a mold, to resist the pressure while it is being cast,) is a lottery, or else it is burdened with an indeterminate 'factor of safety.' The 'proper heat' for casting alloys is at the mercy of the furnaceman, who is supposed to be skilled in this branch of physics.

Haphazard administration is an extravagance, so it is but fair that each department of a manufacturing industry should carry its own share of the responsibility. The function of a business formula is simply to ratify the forces of production and to act as a precedent for future operations. The technical formula is a counterpart of the business rule applied to practical art. The scientific formula is an inflexible dogma which cannot be tampered with with impunity. Each have their place and their uses in the foundry as in other progressive industries. In ordinary circumstances a formula acts as a sensimeter; it indicates the most favorable direction for the energies of the workman, and it puts the reciprocal interests of the employer on the alert. Formulas should be constructed with a view to simplicity, safety and efficiency. The planning of them entails considerable concentration, but as soon as they are hatched, they 'get there.' Why should foundrymen hesitate to formulate something for themselves? Traditions are against them! Bury your traditions, and, instead of making a mental note of failures, keep a diary.

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PATTERN MAKING

Edited by WM. H. PARRY, 664 East 31st St., Brooklyn, N. Y.

Questions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Parry

THE PATTERN-MAKER.

It is announced that the Iron & Steel Press Co., of Cleveland, publishers of the *Foundry*, are about to issue a journal called *The Pattern-Maker*. Henry M. Lane is to be the editor. As this new venture covers a field almost untouched, it would seem to us that if only pattern-makers and their employers will give it their hearty co-operation, it is bound to be a success. It only needs that our craftsmen take an interest in their work commensurate with the intelligence necessary to master the business in all its details.

The subscription price per annum, we are informed, will be nominal, not sufficient to cover the cost. It is well to look at a subscription to such a trade journal as an investment that may bring valuable returns in the shape of points not known before. Just one such kink fully makes up the whole year's subscription price, and who is there that assumes to know everything? The employer of a pattern-maker, or the pattern-maker himself, or his apprentice, who scorns the help of a journal devoted to his best interests, must be pitied indeed.

PATTERN-MAKING.

We are pleased to give in full two admirable papers on pattern-making recently read before the Pittsburg Foundrymen's Association. The fact that a whole evening was given over to the reading of these papers and the interesting discussions resulting therefrom, shows that foundrymen are becoming awake to the importance of getting the pattern-making end of their establishments into closer touch with the general advance of the industry. Let us hope that this may be the means of bringing the Pattern-makers of our Association into a section for mutual study and interchange of ideas. They, as well as the establishments they represent, can only be the gainers thereby.

PATTERN-MAKING.*

By J. C. WARNE, PITTSBURG, PA.

In this paper I shall confine myself to remarks on wood pattern-making as distinct from metal pattern-making, being more familiar with that branch of work. I have divided my subject under the following heads:—Materials, Machinery, Men and Patterns.

Materials:—As is well known to all foundrymen, white pine is almost universally used in the making of wood patterns, it being well adapted in its nature for such service, light, easy to cut, permits of a nice finish, retains its shape, not warping or twisting like other varieties of the fir woods, and if properly taken care of in the foundry will stand a good deal of wear, especially if rapping plates are provided. Its availability in large quantities to meet an ever increasing demand is also in its favor. Taken altogether it is hard to find a wood equal to it, its first cost being considered.

Of all woods for pattern work mahogany is the best, partaking of the nature of both hard and soft woods, being practically impervious to damp, therefore retaining its original shape. Stands a great deal of hard usage, is oftentimes used in preference to iron patterns, particularly so in Europe. Its great expense, however, almost precludes its use here.

Among the hard woods cherry is by far the best, retains its shape fairly well, is not so hard to cut as other hard woods, makes an excellent finish and stands ordinary wear and tear admirably. Patterns of white pine faced up with cherry in the wearing parts will last for years the hardest kind of service, if kept well varnished, such as car wheel patterns.

The writer having had car wheel patterns in almost daily service for ten years, 16 to 20 moulds put up each day from a single pattern and only withdrawn from service to have repairs made to flanges and rim.

The grades of lumber to be used should vary as the job. I mean by this, patterns with only one casting to be made off and little probability of another being made in the future, cheaper material with consequent save can be utilized so long as the lumber is sound and free from checks; a few sound knots do not signify as

* Read at the December meeting of the Pittsburgh Foundrymen's Association.

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these can oftentimes be cut out with advantage by a little discretion of the pattern maker when marking out his material. Lumber full of fine checks, although it may be perfectly clear, is an abomination to the pattern-maker and a source of loss to the buyer both in time and material.

Where large quantities are used it pays to buy largely and store yourselves. Kiln dried lumber is never so good as the naturally seasoned lumber and where large quantities are used it will pay to take the trouble to paint the ends of the planks or boards as this will prevent checking of ends and a considerable saving of material is effected.

For standard patterns where many are required to be made, the lumber cannot be too good. All lumber used in pattern work, whether Nos. 1, 2 or 3 quality, should be well seasoned. It is no economy either for the pattern-maker or his fellow worker, the moulder, to make and use patterns from lumber such as is sometimes used, where the water will ooze out in front of a chisel cut or fly in your face when turned in the lathe. Patterns made from such never give satisfaction and if wanted again in a month or so, owing to shrinkage in wood, have to be dressed over again and the by wood taken off to make it workable.

If this is not done and the moulder gets it, then the moulder has his own troubles in drawing from sand and patching breakdowns, etc., and the job is one of anything but comfort to him and poor satisfaction all around. I am aware it cannot always be avoided but should be eliminated as far as possible.

Racks for keeping lumber on edge and easy of access should be provided in all pattern shops. At the high price at which the best pattern pine is now bought, supervision should be kept on the pattern-makers, who at times are apt to use the very best where a cheaper grade would answer the purpose fully as well.

Gum shellac varnish is the standard article for varnishing wood patterns. The best results are obtained from the best gum shellac and grain alcohol, and many pattern-makers prefer to make it themselves rather than trust to the uncertainty of results obtained from that bought from varnish makers. Still there are some good brands on the market and when you get the one that satisfies yourself and the moulder, who will soon squeal in unmistakable terms if his pattern clogs the sand, why stick to that brand and do very

little experimenting with any other, if you wish to keep yourself out of trouble.

Leather fillets are now used almost universally and have come to stay, especially for a quick job, but for permanent pattern work nothing surpasses the wood fillet. Fillets of putty are also quickly put in and inexpensive if time can be allowed for it to get hard. When varnished over it forms a permanent hard fillet.

Glue necessarily enters largely into the construction of patterns. Avoid cheap grades. The desirable glue to get is one that will set quickly and hold fast. These can be obtained, but if not to be had, as a rule the slow setters are the strongest. If time is the object more than strength, then use the quick setters.

Machinery:—Machinery plays a most important part in the pattern shop. Thirty years ago a circular rip saw, band saw, and lathe, was about all to be seen in an ordinary pattern shop and sometimes the lumber was not even planed. Hand work was then a very large factor in the production of patterns. To-day most pattern shops are, or ought to be, equipped with the best machinery possible to get.

The jolnter is a most useful machine and a great labor saver. No jointer should be permitted to have shop room that will not plane absolutely true, so that work can be glued up straight from the machine. If it takes the place of a hand jointer plane, from which it takes its name, instead of a jack plane, then it fulfills its mission and is appreciated by its users. For pattern-makers, like most other craftsmen, desire to get along with the least expenditure of muscle where possible.

A good band saw with wheels not less than 36" diameter with tilting table, such as can be bought from a reliable house, is also desirable. A small and large wood turning lathe should be provided, also wood trimmers. Universal circular saw table, and for large shops, a swing cut off circular saw. Work benches with quick acting vises, steam heating glue pots, and a liberal allowance of these should be supplied.

For a well equipped pattern shop I would recommend the purchase of machinery from makers who have made a special study of pattern shop requirements and even if first cost is more it will be cheaper in the end.

I have outlined the machinery required in most pattern shops but machinery should be bought suitable for the particular line of

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work the company is engaged in, which the foreman in charge will soon discriminate in favor of.

The end and aim of the best machinery in the world will be defeated if proper care is not taken of same. In most shops it will be usually found there is one man who has the special knack of getting the machines to run just so. That is the man to keep at that work. I do not believe in every Tom, Dick and Harry fixing the machines. What is anybody's job is nobody's job and you get nobody's results. Employers should get all that is coming from the investment and the pattern-makers will appreciate nice true cutting machinery.

Men and Patterns to be made:—Accuracy should be the first law with every pattern-maker. Speed is also a very important factor, but if accuracy is sacrificed to speed, there is too often sorrow all along the line from the pattern-maker to the machinist and much valuable time and considerable loss of money is involved. A good all-around competent pattern-maker should have "an eye like a hawk and a head like a Philadelphia lawyer." This is a definition I once heard but while somewhat exaggerated and overdrawn, still it shows that there must be ability of a high order shown. He should have a thorough knowledge of drawings, able to read same truly and quickly, be no mean draughtsman, and the more his mathematical and mechanical knowledge, the greater chance he will stand for a better position and the more valuable will he be to his employer. He must possess a true eye, which will be found a great advantage to him. On him will devolve largely the amount of labor put into patterns.

If the work to be done is permanent standard patterns, such for instance as steam pumps of graduated sizes, too much care in reason cannot be expended on the job. Parts should be well fitted together, the proper amount of draught given. If the patterns are in halves he will provide the proper amount of metallic dowel pins. Avoid wooden dowels as much as possible, with sufficient number of rapping and lifting plates for drawing patterns. This latter item is too often forgotten and only brought to the pattern-makers notice when he sees the results of the molders draw spike. Always put it in the weakest part of the pattern and where the grain of the wood is shortest. Do not skimp rapping plates, lifting plates, and drawing straps in permanent patterns. It pays for the extra cost and time of putting in.

Coreprints of sufficient length to sustain weight of cores with-

out crushing moulds should be used. The pattern maker who gets his intricate cores correct and to fit the mould exactly has solved one of the most difficult problems in pattern making and will save himself and the moulder who handles his job much sorrow and heartburnings, not to say anything of the cuss words thrown in. Indeed no pattern maker can be considered successful unless he has acquired the faculty of having his cores well fitting and correct. More skill is frequently required in making core boxes than patterns. This is well known among foundrymen.

It frequently happens that a pattern is required for only one casting. I have known men who could not seem to appreciate this fact but would spend just as much time on the job as if there were a hundred required. This is where the judgment of the good pattern maker is shown.

In work of this kind a strong substantial pattern is not necessary, sufficiently strong to retain its shape and stand the molder's handling will do. Extra finish not required. So long as the pattern is accurate in its essentials is all that is necessary. These are the cases where the pattern maker shows his value to his employer in his abilily to discriminate and be governed accordingly. These traits of the pattern maker makeup are more readily observed in men who have been raised pattern makers from their youth up and men who have acquired the trade in after life and have worked at other wood working trades. Of course there are exceptions to every rule.

A good pattern maker will always be on the alert to catch the draughtman's errors, and draughtsmen are liable to err, as every pattern maker of experience knows.

Another feature of pattern making:—oftentimes the expense of a costly pattern can be avoided by sweeping up the work, and a good spindle and socket should be an adjunct to every foundry where machinery castings are made. A little getting together of the foundry foreman and boss patternmaker will often produce a considerable saving in pattern work by the use of the spindle and sweeps. How easy, for instance, a bed of sand can be leveled up for open sand castings, a good level sweep board swung around on a spindle, and you have it, doing away with straight edges and levelling strips, producing better and quicker work as every molder knows. The foundry foreman and pattern maker should work hand in hand. The best results are obtained this way, "two heads," etc.

The pattern maker does not always see a job through the

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moulder's eyes, and his methods can oftentimes be improved by the advice of the moulder, and the moulder will work in a happier frame of mind if the pattern is to his liking.

In the making of patterns it is necessary to have glue in most cases to secure the component parts permanently together, but there are lots of patterns that could and ought to be made with the minimum amount of glue instead of a maximum, as is too often the case. Where glue is exposed to the damp sand trouble is invariably caused, and the less glue the better. There is such a thing as having patterns too securely made, as every pattern maker knows when he has to make some simple changes and finds hubs and prints glued fast and has to break them all to pieces, tearing the under wood with it when he has to remove them, when the unscrewing of a wood screw or a hub or print being loose ought to suffice without the dab of glue under it.

The proper construction of patterns not only for strength in themselves but also to allow of the easiest and least expensive method of molding, is the desirable thing in pattern making, consistent of course with the end in view of all patterns, *i. e.*, the making of the best castings with the least expense to the employer of both pattern maker and moulder, for in these days of sharp competition you cannot afford to be generous either in time or material. Patterns are often made by the pattern maker, especially if the patterns are made in a job shop, with the view of getting the job out of hand as quickly as possible, and the best methods are not used. The moulder has to finish the job at an additional cost of time, which would have been better put on the pattern before it left the pattern shop.

However, you cannot blame the job shops. They have a living to get, and like every one else are not working for glory.

Shrinkage of castings is a very important item in pattern making. In some castings of very heavy type scarcely any allowance for shrinkage will be necessary. In the heavier type of machinery casting 1-12 of an inch per foot; in the lighter grades of machinery castings 1-10 of an inch per foot, and in castings such as builders use 1-8 of an inch per foot. I have found it not wise to have one allowance for all castings as the best results will not be obtained if this is followed. 3-16 of an inch per foot for brass and steel will be found about right.

A few words in conclusion as to the pattern shop. Have it

amply lighted with daylight and fully lighted artificially when necessary; the walls, if brick covered with white wash, and if wood, white paint. If they are not so, first try the experiment of a little white wash and note effects. A comfortable heat should be maintained. If not the effects of glued work will be largely minimised and poor results will obtain. Pattern makers should be crowded no more than necessary. All these things tend to produce successful pattern making.

PATTERN MAKING.*

By EDWARD C. FITZGERALD, Pittsburg, Pa.

Early in the nineteenth century and up until 1840, little was known of Pattern Making as a distinct craft, especially in this country. The man who made patterns, might also build your furniture, or, as in the majority of cases, the millwright of a firm worked in that capacity. This was before the steam engine had been perfected, or the application of electricity, hydrostatics or pneumatics as a factor of power.

Since that time a complete evolution has taken place in this particular branch of industry. Unlike many of the crafts which have been portioned off, until little remains to identify them, pattern making has advanced in technique and skill, until today it stands for more than the mere knowledge of woods and tool manipulation. The man who would make the patterns of the present and of the future, should have a fair knowledge of all the other branches of the industry, have sufficient training in mathematics and also have some idea of design, for it matters not how complete the drawing of the machine or part may be, there are opportunities for the workman to improve so that the finished product may be all that is desired.

Without a knowledge of drafting and moulding this would be impossible.

There are many other factors which enter into the construction of patterns at the present time, the modern methods of moulding, with iron folding flasks and moulding machines, would change the whole arrangement of a pattern which had formerly been made in an ordinary parted flask.

This method of moulding, where feasible, to my mind, is the

* Read at the December meeting of the Pittsburgh Foundrymen's Association.

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best as far as the pattern is concerned, as there is less strain, can be built much lighter, and last longer.

I was somewhat surprised recently while visiting Mr. Fuller of the Westinghouse Electric & Mfg. Co., in Allegheny, to learn to what extent they were using the molding machine. Castings weighing from 16 ounces to 1200 pounds are made successfully. Patterns worked in this manner would certainly last a long time. Either of the above forms of patterns could only be used where they are doing standard work. As the first cost would be too great where only a few castings are wanted. In the latter case, I feel the mistake is made quite often on the point of economy, by rushing a pattern through half finished, in order to reduce this item of expense. Not that I believe that it is necessary to give every piece of work the so called "Piano Finish," but how often have we seen a pattern come into the foundry all bestriped showing the moulder where fillets are desired, when the time consumed in striping could have been used in putting in fillets of leather or some other material, the cost of which would be much less than the time consumed by the moulder in cutting in and patching up, with a much more creditable casting in the end.

Rather than economizing along this line, I would say to see to it that the pattern be such as would make the operations which follow as simple as possible, that time and labor might be saved in the foundry and machine shop.

Personally I know of several instances where after giving the pattern maker proper time to think, not only of the method of making the pattern, but of the work which is to follow, he has not only increased the output but has cheapened the cost of production from ten to, as in one instance, sixty per cent.

Skeleton patterns and sweeps have their place, and little improvement can be suggested at this particular time, however, as in the former case, a few minutes devoted to deep study, would produce the results, at a nominal cost for the pattern work.

I will not go into details in regard to the different branches of the industry, and the pattern work pertaining to each, but rather touch upon some of the most important points that enter into the constructive side of pattern making, classifying them under the following heads:

Working Drawings, Selection of Material, Machining and Shaping, Assembling, Finishing.

WORKING DRAWINGS.—A full size working drawing, in the majority of cases, should be made, allowing shrinkage and showing finish on parts required. Where the piece is too large to permit this, such parts as are most important, or where there is any intricate core work, should be worked out in detail.

This will not only aid the worker, but be of assistance to the foundryman, who could see where he would like templates or test pieces for finding thickness of metal, etc.

The time consumed in this is not wasted, for during this period he is resolving in his mind not only the best method of construction but the simplest way of moulding, which, after all, is the best.

SELECTION OF MATERIALS.—Material should be selected with thought as to quality and fitness for the work required. For large patterns white pine has generally been found to be the most suitable; for small patterns that are worked to a great extent, hard wood or metal is best adapted. Also loose pieces, bosses, lugs, etc., on standard work might be made of either of these materials, as such parts are subjected to more or less wear.

One of the difficulties the worker will encounter is the tendency of woods to warp and shrink, especially in light shell patterns. A good plan would be to keep a supply on hand, of perfectly dry lumber of different thickness, for such emergencies. However, wood is very susceptible to atmospheric conditions and should be kept in a dry place. A rack constructed to store the lumber on edge, with space between each board, permitting free circulation of air, would be both convenient and profitable.

Lumber containing a great amount of sap should only be used in such parts as do not come in direct contact with the sand, as it decays rapidly and is more apt to warp than the heart wood.

For small light work, where the patterns are run in cards, white metal, brass and aluminum are the metals generally used; iron castings off an original pattern if coated with wax to preserve a smooth surface make very good patterns, in fact, some fair sized castings are treated in like manner. This is especially so in stove work.

MACHINING AND SHAPING.—Band saws, circular saws, planers and lathes are built to perform certain functions, and should be used to their fullest capacity in shaping the pattern.

These machines are almost indispensable. The band saw with its tilting table, can be so adjusted that irregular shapes may

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be sawed to the line, thus dispensing with much hand labor that would be necessary without such a tool, The modern universal circular saw, with its many adjustments, saves time and material. Staves for barrel-shaped patterns can be sawed just to the angle without a particle of waste; can also be used for making butt joints in segment work, by fastening a form to the sliding table and using the cross cut saw. For roughing out round core boxes it is a great help; however, in pipe fitting shops the majority of the core boxes are cylindrical, and they have special machines designed to do this.

In preparing work for the lathe, all calculations as to diameters, lengths, etc., should be made as close as possible, so that unnecessary labor in turning off, and waste of material may be avoided. The pony planer and surfacer are valuable machines for dressing lumber to required thickness and shapes.

Where a shop is equipped with a complement of machinery, and a fair size force of men is employed, there should be one man whose duty it is to keep the shop tools in good condition, otherwise they lose a large percentage of their efficiency.

ASSEMBLING.—After the material has been cut and shaped to convenient size for assembling the pattern, it should be put together in a manner to offer the least resistence in drawing it from the mould, where there is great depth and comparatively little draft, it would be better if the grain of the wood run at right angles with the parting or on a line with the lift. In extra heavy work such as bed plates and bases for Blowing Engines, the form adopted by the Mesta Machine Company seems to me to be the most feasible.

The patterns are made in sections with guide strips so arranged that when it is assembled in the pit, all parts adjust themselves to their proper position. This also relieves the strain on the pattern in drawing from the sand, each piece being drawn separately. Patterns for pipe fittings are now made with flanges, branches, and core prints interchangeable. This is an excellent plan, as it makes comparatively few patterns cover a wide range of sizes and shapes, and overcomes, to a certain degree, the old method of patching here and there with pieces to get the size casting wanted. This system is more generally adopted in shops that make a specialty of fittings. Work should be screwed together rather than nailed where convenient to do so. Where glued joints

are required, hot glue is the best for general use, the cold prepared glues are probably better for thin wood, as hot glue would tend to swell the wood, which after drying out would change its shape.

There are many makes of metal dowel pins on the market for parted patterns, and are certainly a vast improvement over the old wood pins, which are apt to swell and cause great annoyance to the moulder, who in his anxiety to make it work free, either gets the pin too small or the hole too large.

In certain classes of machinery, castings are make in pairs, and one pattern is made to perform a double duty by using detachable sections; in such cases all parts that are interchangeable should be properly adjusted and marked, so that the change may be made without inconvenience.

To go into detail in regard to the character of patterns required for dry sand, loam, and chilled work, would make an almost endless paper, as each is worthy of specialization.

FINISHING.—The amount of time and labor required for this last operation is governed largely by the number of castings that are to be made; all patterns should be coated with shellac, varnish, or some such preparation, to protect them from moisture and to give a hard, smooth surface. Patterns that are in use regularly should be varnished and gone over from time to time, the old adage of "A stitch in time saves nine" holds good even in pattern work. Draw plates and rapping plates are essential on good work, they are convenient and might save the pin holes.

Where cores are to be placed in the mould should be shown plainly on the pattern, this is done by using a different color on the core prints from the main body of the pattern. Every firm should have a well regulated system of recording patterns. Raised lead letters is the prevailing form and seems to be the best; and last a store house of ample dimensions should be provided where patterns can be handled to an advantage.

In conclusion, I wish to say, that the Pattern Maker, as time progressed, has evolved from the position he once held in the eyes of an English manufacturer, that of "a necessary evil," to a factor in the net earnings of the firm by whom he is employed.

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DURABILITY OF LAMP BLACK IN SHELLAC.

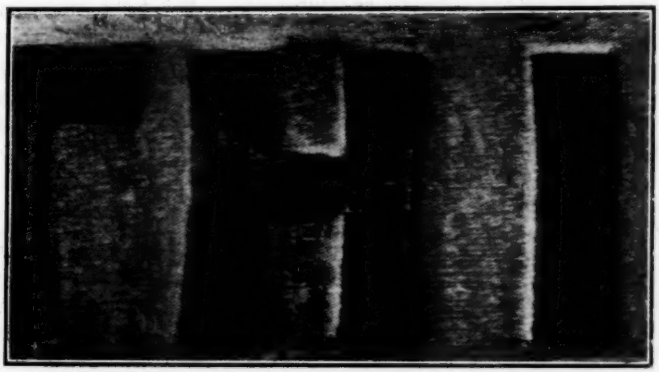
American Machinist, December 10, contains a valuable communication from W. H. S., on the above subject. The accompanying illustration, reproduced below, of an old sign board, weather-beaten except where the black varnish was laid, is a first-class argument for covering all patterns that are to be used continuously with black varnish.

Our own experience of over twenty-nine years at pattern making has convinced us that there is nothing in wasting time in making a pattern look pretty by using yellow varnish, with core prints of some contrasting color. Foundries are of necessity somewhat dirty, and a light colored pattern very often loses its beauty after one casting has been made from it. It is therefore better practice in the end to use black varnish with core prints adorned with some such contrasting color as red, green or maroon, or in fact any color that will give body to the varnish. This latter desideratum is after all the secret of the durability of surfaces covered with black varnish, and if any added proof is needed along these lines, just observe, the next time you handle an old pattern, if there be a surface on which a patch of black varnish shows on the same plane with one of yellow varnish. Now, take a thin shaving off the surface with a plane and note the stock beneath. That below the black varnish has retained its natural color, while that under the yellow has darkened considerably.

We now add the letter above referred to:

"Some time ago there appeared in your columns considerable discussion as to why patternmakers put lampblack in their shellac. Having been a painter in my younger days and having some knowledge of pigments, I had an inkling of the reason, but I had no evidence to support my theory. I wish now to introduce into the case an important witness in the shape of an old signboard which has been exposed to the weather for a dozen years. This sign was gotten up in the pattern shop and we were obliged to use such materials as were at hand. The wood (pine) was given several coats of ordinary brown shellac, and the lettering was done with "black shellac"—*i. e.*, lampblack added to brown shellac. From a painter's point of view the mission of shellac is merely to seal up the pores of the wood and act as a support for the varnish which is usually applied as a finish. It prevents the varnish from striking

in and keeps the pitch from working out. Shellac does not of itself resist the weather well, as is shown by the background of this old sign. Lampblack, however, being a form of carbon, is almost indestructible and serves to preserve both the shellac with which it is mixed and the wood on which it is placed. Consequently the black letters on the sign appear nearly as good as new, while the weather has not only worn the shellac off the background but has eaten away the wood, so that the letters actually stand out to an



appreciable extent as shown in the half tone. Now, if lampblack aids in preserving wood against the effects of warmth and moisture in the atmosphere, this is a good reason for using it on patterns where the warmth is in the form of hot sand and the moisture becomes steam. Lampblack adds appreciably to the body of the shellac,so that repeated coats tend to fill up the small hollows in the pattern. In this case the coating may be softened by heating the pattern over a gas or alcohol lamp, or, better still, by using a burner such as carriage painters have for burning the paint from old work. In this softened condition the gum may be removed by scraping without injuring the pattern.

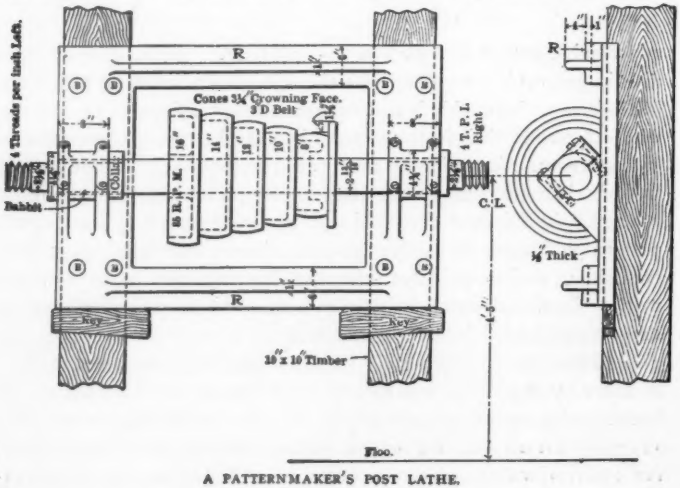
"It may not be generally known that shellac may be dissolved in water by the aid of borax or of sal ammoniac. Use 1 ounce of borax and 5 ounces dry shellac in ½ pint of boiling water, or 1 ounce sal ammoniac to 3 ounces shellac boiling for some hours in half a pint of water. After these water varnishes are dry they can-

not again be softened up by water; hence they are useful in the manufacture of waterproof drawing inks.

"Practically all the shellac in the world comes through Calcutta from the Himalaya Mountains, where it oozes out of the limbs of certain trees, through small punctures made by an insect similar to a louse. By throwing the twigs into hot water the 'lac' is softened so that it may be strained through coarse cloth. If it drops on to a smooth surface it forms flakes or shells, hence the name 'shellac.' If allowed to drip in one place for a little time it forms a button and is known as 'buttonlac.' When the flakes are so small that they fly about like seeds it is called 'seedlac.' The methods of collecting and marketing this valuable gum are careless and primitive in the extreme. Considering the present high price and the enormous amount used, there would seem to be an excellent opportunity for the application of modern methods of production."

A PATTERN-MAKER'S POST LATHE.

American Machinist, October 29, illustrates a pattern-maker's post lathe, with enough dimensions to furnish a good working drawing. Hence we give it herewith. There will be noted one thing we hold an objection. The spindle is threaded on both ends right and left, which is bad for heavy work. Spindle ends turned



A PATTERNMAKER'S POST LATHE.

to a taper of ½ inch to the foot, with taper keys to drive face plates home, and a jack to force them off, are easier handled and give better results for anything over 6 feet in diameter. The description is as follows:

"The frame is designed to stand the heavy work done in a lathe of this kind, the bearings are long and well braced, the spindle or shaft is made from 2 13-16 inch cold-roll, threaded for face plate at both *R* and *L*. It is common practice to cut threads up to the shoulder collar, but they stop here 1¾ inches from shoulder. This is a convenience when putting on face-plate. The blank space in the bore provides a place to hang on when starting to screw it up to shoulder. It is very unpleasant to have to hold three or four hundred pounds up while trying to start a face-plate with threads cut to collar. The cross-ribs of the frame provide for belting from above or from below, also at an angle. The frame is bolted at holes *B* to 10 x 10-inch timbers. When you do a job on a lathe of this kind you have no fear of its going to pieces or that it will wabble so much that you have the jimjams before you finish your job."

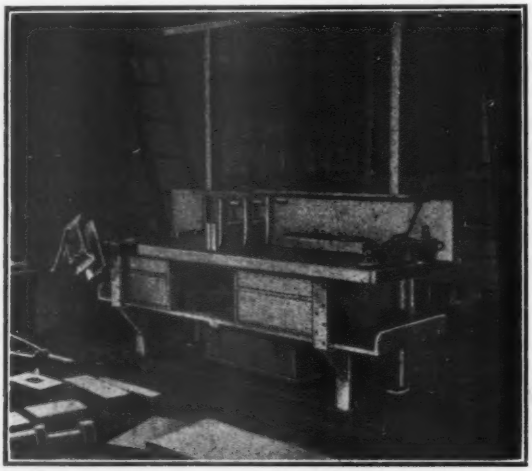
WESTINGHOUSE WORKBENCHES.

American Machinist, October 1st, contains an excellent article on Westinghouse workbenches, by John Randol, the well-known writer on mechanical subjects. The bench is shown herewith, and certainly is a vast improvement over the contraptions one ordinarily sees. It was designed by the foreman pattern maker of the Westinghouse works. Mr. Randol describes it as follows:

"The high, slender, wooden frame at the back of the one bench shown supported a light, wooden electric-light swinging gib, very simple and ingeniously contrived so that the patternmaker could place two bulbs anywhere he wanted them. It is well-known that pattern work by artificial light is extremely difficult, and this arrangement lighted the bench perfectly.

"The benches were new, and different from any others in my knowledge. The one pattern, very cheaply made out of even thickness stuff, all straight lines, served for both bench legs. The straight, verticle front of the leg was cored with peg-holes, and this front was not planed, though it would have been a far nicer job had these two fronts been planed and drilled, instead of being rough and cored. The boss pattern-maker said he had hard work enough

to get permission to have the legs cast, to say nothing of having any machine work done on them. The molder had been careful, and the leg fronts and peg holes were pretty good, so that a wide, long piece could be supported edgewise on the pegs in the leg fronts, which are flush with the front edge of the bench. The back-board of the bench is the thickness difference below the top of the



thick front, and a high back-board, supporting the electric-light carrying frame, is provided with a tool board on top. The bottom board of the bench extends at both ends beyond the legs same distance as the bench top, and has end and back-boards fastened to it, so as to make a deep, capacious tray, open in front, to permit ready cleaning at both ends of the bench.

"The space between the top and bottom, 16 or 18 inches high, is filled at each end of the bench with four drawers, as shown, bottom drawers deepest, and the drawers separated by a large open-front space.

"Although this bench was designed for the express purpose of keeping the shop floor clear of tool boxes, a small 'steamer trunk' tool chest is seen underneath the bench. The Emmert vise is a patented arrangement, having holding jaws on all four sides of the screw, and standing at any inclination within its range, which is

considerable, and also turning round in a vertical plane, and was highly valued by this foreman.

"It will be seen that this very cleverly designed bench is first of all a very simple, cheap and substantial arrangement, and that its back-board top shelf, together with the large, vertical back-board surface, gives a considerable area for placing tools. The back-board is open at both front and rear ends, so as to be readily swept clean. Then the drawers afford much more than the ordinary tool-chest room, and taken with the large trays at the ends, and the large open space between the drawers afford far more tool room than the ordinary pattern bench and tool chest combined.

"It is very common to arrange pattern-makers' benches next to the wall, and undoubtedly this is not the best practice for a shop making large patterns. In fact, it is very far from certain that any shop should have benches run along the walls.

"This Westinghouse pattern shop was very large, and very high, and the benches, I believe, were all to be placed at right angles to the middle open floor of the shop, endwise to the wall, and a passage width clear from it. This arrangement gives several workmen, say four or six, ready access to the same large pattern in course of construction on the open part of the floor, and also places the foreman in a very much smaller hollow square, and so gives him access to the workmen with much less travel, than if the benches were placed lengthwise against the shop walls. It is also to be noted that all conferences between foreman and pattern-makers take place at the foot of the bench farthest away from the vise end, so that, from the foreman's travel point of view, this bench arrangement reduces the total shop width by, say, 15 feet on a side, or 30 feet total, which saves a vast number of steps in a year's time.

"Benches crosswise of the shop and clear of the walls would make the use of wall tool boxes call for much more walking on the part of the workmen than the tool storage drawers shown in these benches. It is true that no arrangement of drawers accessible from the top only can store and display articles nearly so well as the vertically opening tool box with swinging leaves, and but very few workmen have their tool-chest drawers so planned and kept in such order that they can instantly lay their hands on anything wanted."

GRAIN OF LUMBER IN PATTERNS.

American Machinist, November 5th, publishes a letter from Jos. L. Gard, of Denver, on the grain of lumber in patterns. As Mr. Gard, in our estimation, is one of the best writers on subjects falling within our craft, we can do no better than give his letter in its entirety, and without comment, confident that it will be found a most valuable addition to the literature bearing on pattern-making now extant.

"One thing that few pattern-makers seem to understand about lumber, and one of much importanance, is, how the grain of the

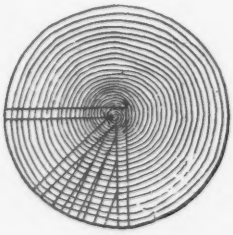


FIG. 1

FIG. 2

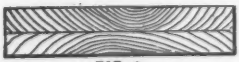


FIG. 3

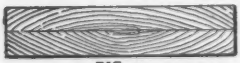


FIG. 4

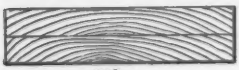


FIG. 5

FIG. 6

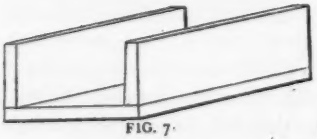


FIG. 7

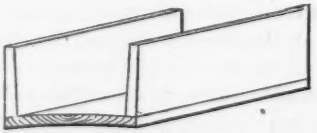


FIG. 8

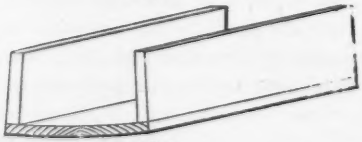


FIG. 9

GRAIN OF LUMBER IN PATTERNS.

wood can be placed to make the pattern most serviceable. When quarter-sawed lumber is spoken of, it is generally supposed to apply to oak or other hard woods, and is understood as meaning a method only of showing the markings on the face of the board.

"But there are quarter-sawed boards in pine or any other kind of lumber. A quarter-sawed board is one that is cut from the log radially, as in Fig. 1. To cut all boards quarter-sawed would waste too much of the log, which is the reason that only a few boards from each log are sawed radially.

"A quarter-sawed board will stay practically straight during many changes of temperature or humidity. So if you have a thin pattern to make that has no ribs to hold it straight, select, if possible, a quarter-sawed piece, which can be easily done by looking at the grain on the end. You may waste a little stock to get such a piece, but just consider the convenience of having the pattern stay the way it was made. I remember an instance of making new patterns to replace some that were badly warped. Cleats were ordered put on the new patterns to be afterward stopped off. I sent the patterns to the foundry without cleats, with word that when they became crooked, to send them back and I would put the cleats on. Bnt I never saw them again.

"A board like Fig. 2 will not stay straight long—which reminds me of the boy who tried to plane such a piece straight; the more he planed the worse it got, until it began to look as if there would be no board left. The boss told him he didn't plane fast enough to keep ahead of the warping.

"When gluing two thicknesses together, it is better to place them so that the grain will lie as in Fig. 3, because the warp of one piece will counteract that of the other, and the joint will not open as readily on the edges as if placed like Fig. 4 or 5.

"If you glue one piece across another you will get the effect of Fig. 6, unless the glue lets go or one piece splits in shrinking. The pull of board *A* in shrinking is often powerful enough to bend board *B* in its length. Cross grain is only effective with absolutely dry material of four or more thicknesses.

"A pattern like Fig. 7 is more serviceable if made with the length of the bottom piece running from one rib to the other, as the bottom will stay straight and the ribs will always draw. If made like Fig. 8 or 9 you get the effect shown, which will distort the ribs so that the pattern will not draw.

"If the grain of the wood can be put in patterns in the same

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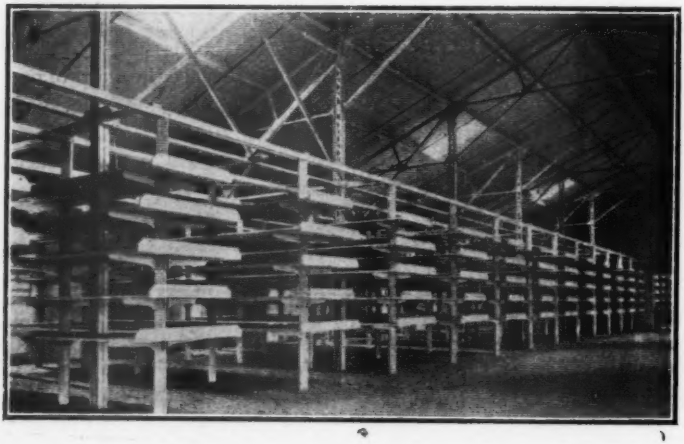
direction as the line of draft, a slight warping will not affect the drawing of the pattern. This cannot always be done, because patterns so made would be weak in vital parts. Distribution of the grain of wood in patterns is as much a study as the distribution of metal, both equally affecting the utility of their respective constructions."

WESTINGHOUSE FOUNDRY CO'S PATTERN DEPARTMENT.

The Foundry, October, contains a description of the pattern building of the above named company. The accompanying cut of the third floor showing an excellent arrangement of shelves for the storage of patterns.

The building is 605 ft. long by 80 ft. wide. The foundations are of concrete and the super-structure brick and steel. Adequate facilities for kiln-drying are provided, though we believe this to be a mistake, as kiln dried wood has proven to be anything but desirable for patterns.

The shop is supplied with a most complete tool equipment, and electrical illumination is supplied by arc and Nernst lights. Now that the Hewitt light is on the market and in successful operation, we respectfully suggest that a trial be made with it in this most up to date shop, for direct illumination over the benches. The hot air system of heating keeps the temperature of the building between 50° and 60° F., and ample toilet facilities are provided on each floor.



FOUNDRY ACCOUNTING

Edited by Kenneth Falconer, 34 Staynor Av., Westmount, Montreal, P.Q.

Questions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Falconer

TWO SHIPS—TWO FOUNDRIES.

Some years ago two sailing vessels left an American harbor bound for a distant port. Apparently they were equally well equipped, found and manned, and, to ordinary observers, they sailed with equal chances of a prosperous voyage. They both had chronometers and charts, but in one point the one possessed an advantage over the other, viz., complete sets of instruments for taking observations, and officers capable of doing so.

While in sight of land both made equal progress, and even after land had disappeared, favorable winds and tides continuing, one appeared to have little, or no, advantage over the other. Getting out of the influence of the trade winds, and reaching the area where squalls drove them alternately towards the different points of the compass, and unseen currents carried them off their proper course, was where the expense involved in the extra officers and equipment carried by the one was fully justified.

It goes without saying which ship best weathered such conditions; which first reached fair trade winds and favorable tides again. That captain who knew each day just where he was, and how far he had gained or lost in the preceding twenty-four hours, made a winning fight against adverse winds and tides, and, ultimately, a successful and profitable voyage. The other lost all reckoning of longitude and latitude and, driven first this way and then that, made little progress, perhaps had to come to at an entirely different port from the one he intended to reach.

Two foundrymen commenced business, one with a thoroughly efficient cost department, the other without any shop, or cost accounting, system at all. While the proportions of the business were such that the proprietors could keep in personal touch with all details both made progress. Even after the business had outgrown these proportions, and so long as conditions were favorable, the difference in the success attained by either was not marked. When conditions became less favorable, when hard times and close

competition had to be met, that foundryman who knew each month just "where he was at," how much he had lost or gained during the preceding month, was in the best position to weather the storms and attain success.

Cost Accounting in the Foundry.

The fundamental importance of accurate and reliable records of costs is perhaps less generally recognized in the business of producing castings than in any other branch of manufacturing. This arises from a variety of causes, but most foundrymen will agree it is not that the profits obtained in their particular business are such that there is no necessity for economy in both management and production. The fact is the more surprising because the output of the foundry forms the basis of the product of such a large proportion of the finished product of other industries; yet many concerns whose product originates almost entirely in the casting shop—who have scientific and accurate methods of cost finding in every other department, either make no attempt to ascertain the cost of the castings which they turn out, or else are satisfied with a more or less accurate record of the average cost of the output of the foundry. No results can be more accurate than the data from which they are compiled, and costs of articles composed wholly or in part of castings are correct or unreliable in exact proportion to the amount of such material they contain, and to the accuracy of the methods of cost finding adopted in the foundry.

A very general feeling regarding this subject was recently put into words by a prominent foundryman in speaking of cost accounting. "All very well for a machine shop, but impracticable and of no practical value in the foundry." In that sentence lies the key note to much of the indifference, not to say *opposition* with which cost accounting is regarded in the foundry. If Foundry Accounting, in distinction to commercial book-keeping, applied to that business, be regarded as a system of records and nothing more, it is of little practical value. If, however, it be recognized that the end of cost accounting is cost reduction;—if the cost system be planned with the main object of showing possible channels of lessening costs or expenses;—if the results it secures are studied in this light, *and judicious action based thereon*, it will prove itself in the foundry, equally as in the machine shop, to be a strong force towards success, and very possibly the determining factor in its attainment.

There is an altogether exaggerated idea of the difficulty of applying the principles of cost accounting to the foundry business, but it would be as logical to argue that specialized insurance accounting is impossible and of no value because methods of bookkeeping of a wholesale business would not apply, as to argue that foundry accounting is not feasible because systems found successful and valuable in other lines of manufacturing would not suit conditions prevailing in the business of casting metals.

Cost Systems, their Breadth and Scope.

Cost accounting is a misleadingly narrow term, and is too frequently taken to refer only to cost of production. An efficient system of cost finding in the foundry, as in any other manufacturing business, should secure, verify and record in detail the costs and the results of all the operations and transactions of the business excepting those strictly financial, but including those altogether commercial. It should equally record and compare the aggregate of sales as of manufacture—of collections as of materials used—of accounts payable as of goods purchased; these in gross amounts, leaving the commercial books to show the same amounts and values distributed under the names of those in the relation of debtor or creditor as the case may be.

As regards the internal or working accounts, a cost system, whether in foundry or shop, should record costs of all operations and transactions in which no outside parties are interested, whether they are incurred in the operation of the business, the maintenance of the equipment, the manufacture of the output, or the disposal of the finished articles. In other words, costs should be taken to include each and every expenditure involved in the conduct of the business from and including those necessitated by estimating and buying to and including those caused both by selling and delivering. Those expenditures or costs necessitated by the fact of manufacture should be recorded in their relation either to the individual articles or classes of product, other expenditures in their relation to some known related factor of the business.

Wage Cost.

Broadly speaking, and in as far as the wage cost of production is concerned, a cost system for any productive business must follow one of two lines—either seek to ascertain individual costs by making each individual article, or lot of similar articles, the subject of

special record during process of manufacture, or seek to find the cost of various classes and qualities of output by making each of the operations which the product, or any part of it, undergoes the subject of individual records, thus obtaining a factor of cost for each class of output for each operation it undergoes. These results in conjunction with a known factor of the product, be it of measurement or weight, affords opportunity for obtaining accurate records of the wage cost.

Except in isolated cases where circumstances admit of castings being each made a subject of individual record, cost accounting for the foundry, in so far as wage cost of product is concerned, must be planned along the latter lines. As a general rule the wages paid for productive labor in the foundry will vary in direct ratio to the weight of the output, or to the weight of some class or quality of output. The relation of wages paid to this known factor will in the majority of cases determine whether any given foundry is being conducted on wasteful or economical lines. If each operation the product undergoes, or every expenditure of labor incurred on account of manufacturing is recorded in this way, and the totals divided by the gross weight, of that part of the output which has undergone each operation, or on account of which such work has been done, we will then have different, but correct, factors per one hundred pounds with which to charge the different lines or qualities of product for labor. In other words, we will have data by which to determine accurately the wage cost of each quality of castings produced, not the average wage cost of the entire product or output.

Material Cost.

As regards the material actually entering into the composition of the output of the foundry, it may be very frequently possible to obtain records regarding each individual casting made, even where it is impossible to treat the wage cost on these lines. In very many cases, however, the alternative of securing records of all the material required for the manufacture of each line or quality of castings, and then dividing its value by the weight of that quality will be found to give better results at a very much less expenditure of time and labor. Thus, if we know that the metal used in the manufacture of two different qualities of castings for a given period amounted to respectively $2,000 and $4,000, and that during that period

were turned out 20,000 lbs, of each quality, we will be absolutely correct in putting the material cost at 10c. and 20c. per pound.

As I stated in our last issue, cost of product in any productive industry is composed of three elements : labor, material and a share of other expenses. I have tried to indicate briefly the principles to be observed in any system of cost finding in so far as the first two elements of cost are concerned. If I have failed to make my meaning clear, or if there if any point which suggests itself for comment or criticism, I will be glad to hear not only from those directly connected with the foundry, but from any interested in the accounting of a productive organization connected in any way with the manufacture of castings. Altho' cost accounting in any branch of manufacture is a department to itself, equally distinct from the executive control of the business, and from the accounting methods of the office, it is nevertheless true that the best results can only be obtained when it is operated in harmony with the one and planned in conjunction with the other. Many otherwise efficient cost systems lose much of their value because not devised and installed to harmonize with and supplement the general system of accounting, and because of a failure on the part of those connected with that department of the business to realize how greatly the value of their work and records may be increased by special methods of accounting work, relating to the internal workings of the business.

THE FACTORY MANAGER AND ACCOUNTANT.

By HORACE LUCIEN ARNOLD *(Henry Roland)*.

We are in receipt of a copy of the above work on cost accounting, by one who ranks high on that subject. Mr. Roland's name is guarantee that the book will be of practical value to those interested in this detail of the management of industrial organization—this branch of accounting work.

The book contains descriptions of several complete systems of factory accounting (with illustrations of the forms used) which have been found of value in some of the foremost establishments in the United States. At a later date we hope to examine some of these systems in so far as the subject treated of is related to the foundry. For the present we wish simply to call attention to the significance

of the title chosen by Mr. Roland, the bracketing together of the duties of the factory manager and the factory accountant. This we take as a direct though (we cannot help thinking) tardy recognition of the fact that the work of the accounting department, in so far as it is specialized to suit the nature of any business, is not, as the science of accounts is so frequently called, "only clerical work." On the contrary, it is very largely concerned with the executive control of the business,—its accuracy is not merely a question of the correct recording of results, but is a direct factor in securing those results. Ultimate success may equally result from the work of the accountant, as the manager,—ultimate failure be equally caused by inefficient cost accounting as by incapable management.

To WHOM IT MAY CONCERN—Word has reached us that whenever friend Loudon stays to supper, he is always careful to see that enough is left for his breakfast.

THE FOUNDRY FOREMAN.

Edited by JAS. A. MURPHY, Secretary of the Foremen's Section of the Association.
Address all correspondence direct to him, to 114 West 20th Street, Erie, Penna.

ERIE FOUNDRY FOREMEN.

The pioneer branch among local foremen's associations is still doing business with a vigor that others could profitably copy from. Two meetings per month are devoted to the technical training of apprentices, and a marked improvement is already noticed among the young men. Copies of the Instruction Papers of the American Foundrymen's Association are among the regular literature distributed gratis.

CHICAGO FOUNDRY FOREMEN'S ASSOCIATION.

A strong branch of the Associated Foundry Foremen was organized in Chicago, during the month of November, and a committee appointed on constitution and by-laws. The officers elected were as follows:

President, C. E. McArthur, The Western Electric Co.
Vice President, M. C. O'Connor, Allis-Chalmers Co.
Secretary, Hector J. Holmes, Brown Bros. Mfg. Co.
Treasurer, John Balkwell, Davis and Ludwig Foundry Co.
Sergeant-at-arms, E. J. Welch, Bolter & Sons Foundry,

INDIANAPOLIS FOUNDRY FOREMEN.

A particularly healthy branch of the Associated Foundry Foremen was also organized in Indianapolis during the month of November, thus making two good divisions during the last quarter of the year. The officers are : M. Barmore, President; W. Holmes, Secretary; and John Reynolds, Treasurer.

THE IDEAL FOREMAN.

The September *Foundry* has a very well written article on this subject from the pen of Mr. Paul R. Ramp. He holds, as all right thinking foundrymen do, that the Foreman should be a thorough mechanic, and able to show the men that this is the case. He pays a tribute to the man who maintains his dignity by not doing thusly: "Some foremen have strange ideas about maintaining

their dignity. I have known several who would not under any circumstances carry a pattern or core box to any point of the shop, or do anything that resembles real work, or dirty their hands, for fear of appearing undignified in the eyes of their men. I do not consider men with such ideas valuable as foundry foremen."

Mr. Ramp also makes it clear that the chair-warmer is not a very profitable man, and heavily scores the *genus Bulldogibus* foreman in the following terms : "I do not consider it essential to the output or success of a foundry for a man to go about the shop with a scowl on his face or an oath on his lips. Even the most depraved creatures respect a clean man. While I would not recommend that a prayer-meeting be held in the shop, I consider it necessary that the foreman should be a gentleman."

CORRESPONDENCE.

MR. JAS. A. MURPHY, Erie, Pa.,
Dear Sir:—

I am a young foundry foreman with only a moderate amount of experience and shall be thankful for some information on the following:

I am making some steam cylinders that must stand a test of 25,000 lbs. per sq. in. tensile strength. They must be close grained and soft to machine.

Kindly let me know what irons I should use and the analysis of the mixture. Here is what I thought of using: Combined Carbon, not less than 0.50; Phosphorus, not over 0.05; Manganese, similarly 0.30; Silicon, 1.75, and Sulphur, 0.05.

Several of our foremen can probably alter this mixture to a more profitable point, and thus help a young member.

MR. JAS. A. MURPHY, Erie, Pa.,
Dear Sir:—

We are using pig iron only in our cylinder mix, doing it because pig costs less than scrap. Is there anything wrong in principle in this practice?

The fact that pig is the cheaper would indicate that many pre-

fer scrap up to a certain limit in a mix. Is this true, and why?

Our cylinders are good for the most part, but when we get a bad one it is lost for either one of the following causes: 1st, what I would call a shrink (I am sending a sample by express) in a heavy section of metal near where it joins a thin rib, or wall; 2nd, cylinders are porous, apparently soft. All these cylinders are air cylinders, completely water jacketed, water at 100 lbs. pressure is introduced in jacket space, and sweats through finished wall inside of cylinder, or squirts out in many hair like streams. Now, I think you will say in regard to the last named fault, that it is due to iron being too soft, but while that may be the case, I am at sea, for the reason that we have irons very low in silicon, so low in fact that it may be difficult to procure irons that will enable us to go lower, and the only way I know of out of this difficulty is to increase sulphur, which is also low, but since we are taught that sulphur is always a detriment (is this not true) it jolts me, in the present state of my knowledge of mixing, to deliberately add it.

The following is the analysis of our present mix, also names of irons :

1000 lbs. Cherry Valley, Silicon .82 per cent; Sulphur .029 per cent.
1000 lbs. " " " 1.07 " " .026 "
1000 lbs. Seneca " 1.38 " " .026 "
15 lbs. Ferro Manganese in cupola.

This may furnish something for the Journal, but meanwhile I shall greatly appreciate it if you will write me direct, giving your deduction.

Thanking you in advance for prompt attention, I remain,

Yours sincerely,

FOREMAN

We have comunicated our views to correspondent, but would be glad to have other members do likewise, through the medium of this Journal.

THF METALLURGICAL SECTION.

Edited by HERBERT E. FIELD, Secretary of the Metallurgical Section of the Association, Address all correspondence direct to him, P. O. Box 104, Ansonia, Conn.

COMMITTEE ON STANDARDIZATION OF METHODS

One of the important things taken up at our last convention was the question of standardizing the methods determining the constituents of cast iron. Much work had already been done by the Secretary of the section in the way of compilation of methods, a substantial little volume giving proof not only of the tedious work involved, but the necessity for bringing together in some measure the widely varying routine of operation.

A committee was authorized to take this matter in hand, and by distributing the work of investigation intended to reduce the numerous variations of detail, among the separate members, expected to bring about some substantial results looking toward a standardization of chemical methods.

The committee is not yet completed but the following gentlemen and firms have volunteered to act in this important matter. Messrs. Booth, Garrett & Blair, Mr. A. A. Phlegar, of the Virginia Iron, Coal & R. R. Co., Mr. J. R. Harris, of the Tenn. Coal, Iron & R. R. Co., Mr. Henry Souther, of the Henry Souther Engineering Co., and Mr. A. P. Ford, Crane Co., Mr. W. G. Ireland, of the Griffin Wheel Co., Mr. J. O. Handy, of the Pittsburg Testing Laboratory, Mr. W. G. Scott, of the International Harvester Co., and Mr. H. E. Field, the Secretary of the Section.

It is with great pleasure, furthermore, that we chronicle the kindness of the following gentlemen, who have volunteered to abstact articles of interest to the foundry and blast furnace metallurgists.—Messrs. R. F. Flintermann, H. C. Loudenbeck, W. M. Saunders, R. S. McPherran, H. E. Diller, A. S. Mitchell. The editor of this department expresses his thanks for this assistance, and feels sure that the profession will greatly appreciate the spirit shown. The articles whether appearing in this or other departments will have the initials of the authors added.

THE ESTIMATION OF TITANIUM.

Journal of the American Chemical Society, October, contains the

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results of a critical examination, by J. Watson Bain, of the methods proposed for the estimation of titanium.

Mr. Bain classes titanium with a select few of the elements "which have won for themselves a reputation based upon the tediousness or the difficulty of the preliminary separation from other constituents which may be present."

After relating many experiments performed, he concludes: First, that the volumetric methods proposed are inaccurate. Second, of the gravimetric methods, the one suggested by Gooch and modified by Blair (Analysis of Iron and Steel, 4th edition, p. 179) and by Charles Baskerville, to give quick and accurate results.

Baskerville's method briefly is as follows: One-half gram of ore is fused with one-half gram sodium fluorid and 5 grams potassium bisulphate, and the mass dissolved in water, containing a little nitrid acid, by boiling. Ammonia is added until alkaline, the hydroxid filtered, washed with hot water, and redissolved in hydrochloric acid. This solution is then neutralized with ammonia. The total volume should not be more than 100 c. c. Sulphur dioxide is passed into the solution until saturated. After boiling from three to five minutes the precipitate is filtered and washed with hot water, ignited and weighed as titanium dioxid. If the latter is not perfectly white the process is repeated.

While this method gives good results with ores, the one described by Blair will, we think, meet with the approval of chemists working on pig iron. W.M.S.

THE SEPARATION OF IRON FROM MANGANESE BY THE ACETATE METHOD.

A. Mittasch (*Zeit. anal. Chem.*, *92*, *492-509*). The author recommends, as the result of his experiments, the following method: The acid solution of 100 c. c., containing about 3 gram of iron and manganese, is treated with ammonium carbonate. This is added from a burette until a faint, permanent turbidity appears. From 3 to 5 c. c. of double normal acetic acid are then added if commercial acid ammonia acetate is used, or 10 c. c. if the neutral acetate is used. After dilution to 400 c. c. the liquid is brought to boiling point and 20 c. c. of a normal neutral acetate solution are added and the beaker kept over the flame for a minute. The precipitate is collected, washed with water containing ammonium ace-

tate and acetic acid, dried and ignited. Ignition in a closed Hempel's oven gave too low results.

The best results were obtained when the amounts of acetic acid and neutral acetate were in approximately molecular proportion to one another. By adding a large amount of the neutral salt, errors due to too large an excess of acetic acid may be obviated. H.E.D.

THE RUSTING OF IRON.

G. F. Moody. *(Chemical News, December 11, 1903.)* The author's experiments showed that salts of strong acids, such as the sulphates and chlorides of the alkalies, and of calcium, etc., have no retarding influence on rusting; and that there are two classes of compounds which inhibit rusting. In the first class are those substances having an alkaline reaction, such as sodium carbonate, hydrate, phosphate, and borate, ammonium carbonate, etc. The second class includes salts of weak acids, such as potassium nitrite, ferrocyanide and chromate, and sodium nitrite, formate and acetate.

The fact is then remarked that the first class of these salts directly absorb and combine with carbonic acid, and that those of the second class are all decomposed by carbonic acid; while the salts which do not retard rusting do not combine with, or are not decomposed by carbonic acid.

From this the conclusion is had that the influence of any compound on the atmospheric rusting of iron depends on its behavior towards carbonic acid, and that those substances which combine with, or are decomposed by carbonic acid inhibit rusting. H.E.D.

DETERMINATION OF SULPHUR IN IRON AND STEEL.

Chem. Zeit. 1903, XXVII, 729. A Kleine describes a new apparatus for this purpose, which is shown in the illustration. It is put together with rubber stoppers. The upper part of the apparatus is a hollow vessel which serves as a condenser. The vapors leave the flask at F, where they enter the worm inside the condensing vessel, and from there go into the triple receiver. The stoppered tube funnel passes through the condenser as shown. It may, if desired, be fitted at its mouth with a leading tube, for the supply of a current of carbon dioxide or hydrogen.

METHOD. The receiver is charged with 50 c. c. of a so-

lution, made by dissolving 20 grammes of cadmium sulphate in 400 c. c. of water and 600 c. c. of ammonia. Ten grammes of steel, or five of iron, are put into the flask and 170 c. c. of hydrochloric acid (7 pts. acid to 10 of water) are added through the funnel. The flask is heated until all is dissolved. The cadmium sulphide is collected on a paper, which without being washed, is thrown into a

200 c. c. beaker half full of water. It is then mixed with a little starch and hydrochloric acid, and treated with iodine solution.

In order to avoid loss of sulphureted hydrogen, 75 c. c. of hydrochloric acid (300 c. c. of acid to 850 c. c. of water) are introduced gradually while the iodine is being added.

THE MICROSCOPE IN ENGINEERING.

Cassier's Magazine, November. Mr. J. L. Hall dwells on the part which chemistry has played in determining the quality and value of all kinds of materials of engineering. There are however many cases where knowledge of the composition has entirely failed to explain peculiar conditions in certain materials, and in many such cases a correct solution and explanation was secured only by the aid of microphotography. It must be understood however that the microscope cannot always solve doubtful questions and cannot always be practically applied. Nor can we expect as much from chemistry, although perhaps some chemists would have us believe so. Yet the two together—a study of composition and of structure

may give practical and useful data, where either alone would have failed. Wherever the investigations of metallography are undertaken along any definite line, many data are amassed, which apparently have little practical value and cannot be practically applied. These same data however have often proven valuable where such investigation has been carried far enough. The writer is confident that such will be the case with cast iron. The latter presents a field which has been barely touched by this method of investigation but as the investigators find time to take it up, the same progress may be expected here as has already been made in the case of steel, alloys, and other Metallurgical products.

Above extracts bring forcibly to mind Prof. Sauveur's interesting talk during the Boston Convention in June, 1902. While many members shared the opinion that the presence of graphite in the softer irons rather obliterated results obtained, the value of metallography in case of harder and chilled irons was at once recognized. In case of hard and annealed malleable iron the micro-structure ought to be of the greatest help. And yet the writer of the above may be correct, when he states that the knotty problems encountered in cast iron in general will find solution as this branch of metallography becomes more and better established. Since other materials have succumbed, why not cast iron? R.F.F.

AN EXAMPLE OF THE ALTERATON OF FIRE-BRICK BY FURNACE GASES.

American Institute of Mining Engineers, October, 1903. In writing upon the above subject Mr. Frank Firmstone calls attention to the change in fire-brick in a blast furnace lining. The brick was taken from the lining at a point between 30 and 40 ft. from the bottom of a furnace which had burned out in a peculiar way. The lining was made up of 14" x 6" blocks, second a layer of 2 " loam, third 13½" of 9" fire brick, laid in English bond, fourth red brick to within 2" of shell, fifth of slag-wool between the red brick and the shell. The furnace was "blown in" in May, 1902. In March, 1903, the whole of the 14" lining had disappeared for more than 20 ft. down from the top, and a few weeks later the 13½" lining and the red bricks had also disappeared. The analysis of the brick which is given below was taken from the 13½" lining. The

surface of the brick which had been in contact with the material in the furnace was covered with a yellow translucent glaze from 1-32 to 1-16 in. thick. The following analyses by Dr. P. W. Shimer, were included:

Analyses of Parts of the Furnace Lining.

Components	Glazed Skin about 1-32 in. thick	Body of Brick (c)	Joint (b)
Silica	40.23 per cent	57.63 per cent	per cent
Alumina (a)	12.22 "	31.64 "	
Iron Protoxide	11.93 "	3.73 "	6.60 "
Lime	10.92 "	0.24 "	
Magnesia	4.41 "	0.11 "	
Potash	9.39 "	2.59 "	2.39 "
Soda	8.43 "	0.51 "	0.79 "
Metallic Iron	–	1.51	
Zinc Oxide	–	0.59	
Total	97.43	98.55	
Total Iron	9.28	4.41	4.62

(a) Includes any titanium oxide present.

(b) The bricks were laid in a mortar of ground clay and crushed brick both furnished by the makers.

(c) Sample taken at least one inch from glazed surface or any joint.

Analysis of Brick from the Same Makers Before Use.

Components	9 in. brick used in lining, 1902. Per cent.	Brick made in 1896. Per cent.
Silica	55.62	56.12
Alumina (a)	38.55	37.48
Iron Sesquioxide	4.17	4.43
Lime	0.24	0.36
Magnesia	0.24	0.29
Potash	0.95	0.99
Soda	0.29	0.23
Total	100.06	99.90
Total Iron	3.10	2.92

(a) Includes any titanium oxide present.

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CAST IRON.

CHILLED MACHINE TOOL WAYS.

American Machinist, October 8. We are glad to note that builders of machine tools are taking advantage of the peculiar properties of gray iron wherever they can with advantage to the work in hand. The closing up of the grain of gray iron by casting it against a chill is the latest, and gives a very much harder wearing surface where most needed. Mr. Henry Hess, who writes the article, found that he had to combat the idea in Europe that our irons are much softer than theirs, especially the English ones. In an editorial in the above quoted Journal surprise is also expressed that this impression prevails in England when it is known that comparatively heavier percentages of Scotch irons (softeners) are used in the English mixtures than in ours. Very probably this impression comes from the well-known methods we use of cutting away iron at high speed, supposedly soft irons only allowing this. Mr. Hess found that with chilled ways on his machine tools, this argument did not require refutation, while introducing them in Europe. We hope to hear more of the application of advanced foundry methods in the production of high grade machine tools.

THE RELATIVE HARDNESS OF AMERICAN AND EUROPEAN CAST IRON.

American Machinist, October 22. Mr. J. E. Johnson, Jr. calls attention to an article published in the *American Machinist*, of October 8, 1903, Page 1417, by Henry Hess, on "Chilled Machine Tool ways" and also to editorial comment in same issue. The impression prevails abroad that American machine tools are universally softer than European made tools. That this is practically unfounded has been the conclusion of many who have been in a position to make comparisons. The editorial comments further, that it is much more likely that the United States is the home of the hard iron while with European castings (at least with English castings) the reverse should be true. This seems reasonable since in years past we were to a large extent dependent on imported Scotch irons for softeners, and probably used a smaller quantity of such iron than was used abroad, where these same Scotch irons may

even have formed the principal ingredient of cupola mixtures.

However there is this difference of opinion about the relative hardness of foreign and domestic cast iron and Mr. Johnson points out a possible explanation. The reason may be found in the high sulphur which prevails in English irons. While the reason for such high sulphur may not be plain, it may be due to the fact that blast furnace management has not kept pace with progress along this line in this country. At least it is generally conceded that English irons run universally higher in sulphur.

This higher sulphur may be the reason for this controversy. The writer thinks that the chilling or surface hardness due to high sulphur penetrates the casting to a small depth only, that is, such a chilling is more active on the surface than on the interior. With the same degree of chilling or surface hardness caused by lower silicon, it would be found at the same time that the interior was much harder than in the first case. Thus in case of the high sulphur castings the skin might be hard to remove but the softer interior would machine easily. With European castings in one case possibly opinion regarding relative hardness has been based on difficulty of machining castings, that is removing skin and all;while in the other case opinion is based solely on character of the finished surface.

Any other explanation from those in position to know is asked for.

R.F.F.

PICKLING CASTINGS.

Railroad Herald, August. From *Machinery* we take the following in short abstract: There are two general methods of removing the scale from castings which have to be machined. Either the scale is removed by means of the sand blast, or pickling in either sulphuric or in hydrofluoric acid is resorted to. In mixing either of these acids with the water, the acid should always be poured into the water, otherwise serious explosions are likely to occur. Sulphuric acid will not attack the scale, but dissolves the iron under it. which allows the scale to be brushed off. Hydrofluoric acid, per contra, eats the sand and scale, leaving the iron untouched. For this reason the latter acid is used for nickle plating work, the surface of the iron being left clean and bright. Sulphuric acid, by dissolving the iron, leaves the graphite, which means a dirty, black

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and pitted surface very hard to plate properly. Hydrofluoric acid comes in three strengths, 30, 48, and 52 per cent., the balance of the liquid being water. The 30 per cent. is the best to use in the foundry, being further diluted with 25 parts of water for the bath. Contrary to the claim of the article, that the acid bath should be cold, though not freezing, the reviewer has always had the best success with a hot bath, a steam pipe furnishing the necessary heat.

ACID PROOF CASTINGS.

The Iron Age, September 24th, gives a mixture for acid proof castings, contributed by Mr. O. Nagel, of New York. He has observed that this mixture gave good results when resistance to acids was required from the castings. He states that the irons must be free from sulphur and copper, which presumably means that these deleterious substances should be as low as possible. Here is the composition:—Silicon, 2.30; Manganese, 0.41; Phosphorus, 0.20; and Total Carbon, 3.60.

ANNEALING CAST IRON.

Eisenzeitung, 37. Mr. Carl Rott, the well-known German Foundry Engineer, discusses Mr. Outerbridge's recent article on a new process for making castings, in which he takes high silicon irons, chills the working surface, and then anneals in the open fire, thus obtaining better strength and service properties. Mr. Rott holds that this is not a new process by any means, and in fact was well known in America even as far back as 1883, being extensively used in making glass molds. It seems that the working surface of these molds were cast on chills and the annealing afterward given the work was such that these surfaces were very soft and could be readily engraved, whereas the other portions of the casting were no better than ordinary gray iron. The process is entirely different from that of malleablizing a casting, for there only low silicon irons are used and the strength obtained is much higher. Mr. Rott incidentally states that his attention was first directed to the matter in order to imitate this iron gotten from America, so that the importation of glass mold, might cease. He succeeded in this by employing irons from Spanish ores which had suitable compositions. At present Mr. Rott prefers to improve his castings by the

use of steel scrap, as this gives a uniformly good product, the process above described benefitting only the part of the casting affected by the previous chilling and subsequent anneal.

THE SHAPE AND METHOD OF CASTING TEST BARS

Stahl und Eisen. November 1. A very interesting series of experiments were recently made by Mr. P. Reusch, the discoverer of the desulphurization process by manganese ore in the cupola, on the shape and manner of molding test bars, as affecting their strength. Those specially interested are advised to study the numerous and elaborate tables. The results show very conclusively that a test bar should be molded without joints, should be cast vertically, should be round in section, should be approximately the section of the casting it is to represent, and should be poured bottom up. The last two desiderata, with which we agree from a scientific stand point, are difficult to work out in every day practice. Casting molds from the bottom up is an expensive proceeding when applied to test bar work, and neither the founder nor the buyer will stand the extra cost over the top pouring through a funnel gate, the bottom of the pattern being rounded off to prevent splashing of the falling metal, Furthermore the selection of one fairly large section for a test bar answers practical purposes better than a different bar for every thickness of casting made. The results are more comparable. We are especially glad to note that Mr. Reusch's results corroborate the work done under the auspices of our Association a few years ago, the final results of which will be given out in our next issue.

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MALLEABLE IRON STOVES.

The Foundry, December. Mr. John Magee, our Vice-President for New England, writes very interestingly on a subject that has worried many a stove man of late. Himself a prominent stove plate founder, the following lines from his pen will be of value:—For some months past the stove trade has been much amused by a series of articles and comments on the use of malleable iron in the stove trade which have appeared in the trade journals. The discussion was started at the Milwaukee convention of the American Foundrymen's Association, and was given additional impetus by an editorial in the *Iron Age* under date of June 18. It is hard for any one conversant with the need of the stove trade to imagine anything more unsuited for the construction of a modern high grade range than malleable iron, and it certainly is not "making distinct headway in displacing gray iron," as is stated by one writer.

For small handles, shakers, knobs and fittings there is nothing better than malleable iron, but this is an extremely small and limited use, and there are many large difficulties in connection with the construction of a malleable iron range. The sale of the steel range with a malleable top has had a sporadic growth in certain sections of the country, at various times, but has never lasted after the true worth of the goods has had time to show itself. The fact that a malleable stove top may be struck with a sledge without breaking is enough to make sales in some districts that have had no experience, but after a short time when the material has had time to become deeply pitted with rust; when the poor fit of the parts, not so apparent in new goods, has had time to show itself; as the joints have been thrown out of alignment by expansion and contraction, and when repairs have been ordered and it has been found that they do not fit well, then there is a strong reaction in favor of gray iron goods.

The only fact that recommends malleable is its strength. It will not radiate heat as easily as gray iron; it cannot be made to maintain a uniform size in the finished casting so that there is no guarantee that repair castings will fit after they have been annealed; the annealing process destroys any fine finish that the casting may have had; and malleable rusts more readily and pits more deeply

than grey iron. In short with the one exception of strength it is impossible to imagine anything more unsuitable for range construction on account of excessive cost, the difficulties of manufacture, the poor finish and wearing qualities. Some of the articles that have appeared hail malleable iron as the ideal stove material of the future, but those who are conversant with the facts of the case know the fallacies of this view.

UNIFORMITY IN MALLEABLE HEATS.

The Iron Trade Review, September 10. In an article describing a patent on producing uniformity in molten material, recently granted to Dr. R. Moldenke, a number of interesting things are brought out in connection with the "malleable" process. We quote the following:—

"Those who are familiar with this branch of the foundry trade will know that when the bath of metal is skimmed, and 'up' in heat, so as to be ready to pour, the tapping of the melt at its lowest point brings out the metal from the lower part of the bath first. This metal is usually much colder than at the top of the bath, where it has been under the full stress of the flame, and yet it is generally from this top iron that the test plug is cast, on which the metal from the bath is adjudged ready for pouring or not. The consequence of this is that usually the first iron is too cold for thin castings, as these will not run properly. It is also too cold for the heavy work as this will not chill properly. It will only do for the medium classes of castings, to pour which, and not the others, is the earnest endeavor of the foreman in charge, with more or less chances of success. Castings which are mis-run are weeded out and charged to profit and loss. Castings which are 'low', that is, badly mottled or even gray, and not detected so easily, and the result of the anneal is bad iron only observed by the customer when something breaks. We will suppose the stream to be running from the furnace at the usual rate of about three-quarters of an hour for a ten-ton heat. The top iron was just right when the metal was tapped. this top iron is the last to come out, and doing so over half an hour after it was of proper composition and temperature usually means 'high' or partly burned iron. This is the case, no matter whether the fuel was cut off or not, as the highly overheated iron is certain to absord gases, and deteriorate in quality. The consequence is

metal which may show only small pin holes, or may be so badly burned that it will not anneal at all. Here, then, is a loss also, and it is perfectly well understood in the malleable foundry that the end of a heat may not go into important light castings, where its use would seem most desirable. Often the last of a heat goes directly into annealing pots, to avoid any chance for trouble. With about one quarter of a heat liable to cause difficulties, there is little wonder that attention has been given to the matter by the best minds, and the only solution of the problem would seem to get the hot metal off the top first, in fact, reverse the usual method of tapping, as it were. The heavy slag cover protects the metal in the steel process, so also the slag formed in the air furnace, where gray and chilled castings are made, though this is by no means perfect. In 'malleable,' however, the very thing that seems most essential, the getting of the top iron first has heretofore been impossible. The most rational solution is therefore the tilting furnace. Here we have the ideal condition of pouring off the hot iron from the top just as we wish. The last iron comes from the bottom, where it was least affected by the gases, or subject to the reactions going on in the bath, the uniformity of a bath of melted metal not always being as perfect as is generally imagined. The tilting furnace has several disadvantages, the two most important being the great first cost, and the high bills for repairs. Malleable works do not invest in large units when it comes to melting iron, the sensitiveness of the process, when taken in connection with the time it takes to run out a heat, precluding this. So the tilting furnace will remain away for some time yet. In the patent referred to the arrangement is to replace the usual single spout placed at the lowest point of the bath, by two or more at different levels, the idea being to tap the upper one first. When the top of the metal is thus removed, the second spout is tapped. Then the next, and so on. In actual practice a 15-ton furnace is provided with three such spouts, and experience shows that when the upper iron is off, the heat may be left under fire for some time before it becomes necessary to tap again, to prevent burning. The important point is gained in that the iron is never overheated to endanger its quality as 'malleable' where this method is used, and the cost of the furnaces is no more than the ordinary. In actual practice with this arrangement, the heat is tapped three times into six-ton ladles each time, this metal after being brought to the proper distributing point, goes into the

regular shanks and hand ladles. Usually the last 500 pounds are left in the first ladle when it goes back to the furnace, the second pour, and finally the last pour is used to the last drop in all classes of castings indiscriminately, the first ladle going into everything but the smallest work, this on account of the chilling effect of the crane ladle and hand ladles combined, before the molds are reached. The process is however equally good for the regular method of catching the metal off the spouts in the hand ladles, or for chill roll work or gun metal from the air furnace.

PIG IRON.

This department has been established for the use of producers and distributers of pig iron. It is not intended to be an advertisement of their material, but to impart information to foundrymen who are often unable to locate the brands and compositions they want. Correspondence and the free use of this department is urged upon the furnaces and selling agents, who may thereby gain wider fields, and at the same time place the foundryman in position to select from a larger variety of irons than he could before. Communications should be sent direct to our "Journal," P. O. Box 432, New York City.

	Silicon	Sulphur	Manganese	Phosphorus	Total Carbon
ROGERS, BROWN & CO.					
Victoria,	1.50 to 5.00	.019 to .053	1.89 to 2.17	.33	
Buena Vista,	.61	.019	1.65	.30	4.00
Gem,	1.00 to 3.00	.015 to .06	1.50	.60	2.85 to 3.55
Alleghany,	1.00 to 2.75	.03 to .07	1.25	.60	3.60 to 3.93
Crane, Topton, Macungie, Allentown	.75 to 3.50	.025 to .06	.75	.75	3.15 to 3.70
Henry Clay,	1.50 to 4.50	.03 to .06	1.00 to 1.30	2.50 to 4.00	3.25
Macungie Malleable,	.75 to 1.50	.04	.75	.15	
Crane Low Phos.	1.00 to 2.00	.015	.15	.025	4.20
Oxford,	.60 to 1.00	.01 to .05	.65 to 1.00	.65 to .75	
Greensboro,	.75 to 5.00	.03 to .06	1.00 to 1.30	.50 to .75	3.75
SUPERIOR CHARCOAL IR'N CO.					
Pioneer, Marquette, Excelsior, Champion,	0.0 to 2.90	trace to .018	.30 to .70	.15 to .22	
Antrim, Elk Rapids, Michgn	0.0 to 2.50	trace to .018	.30 to .70	.15 to .22	
Penninsula,	0.0 to 1.90	trace to .015	.25 to .40	.15 to .19	
Crescent,	0.0 to 2.50	trace to 0.15	.25 to .40	.15 to .19	
H. R. DURKEE, Chicago,					
Ashland,	5 to 10.00				
Briar Hill,	1.00 to 1.25	up to .05	.65 to 1.00	up to .15	
Low Moor,	2.00 to 7.00	up to .05	.60 to 1.00		

PROCEEDINGS.

PROCEEDINGS OF THE PITTSBURG FOUNDRYMEN'S ASSOCIATION.

The first meeting of the season was held at the rooms of the Engineers Society of Western Pa. Mr. Chas. G. Smith, of the Charles G. Smith Co., of Pittsburg, read a paper on Emery Wheel Practice in Foundries (which was reviewed in our last number), after which a nominating committee, consisting of Messrs. McLaren, Froham, and Backert, was appointed to present names for the officers to be elected at the October meeting.

By the courtesy of the Mesta Machine Co. the October meeting of the Association was held at their offices at West Homestead. This being the annual meeting, the following officers were elected for the ensuring year. For President, A. W. Slocum; Vice President, S. H. Stupakoff; Treasurer, J. S. Seaman; Secretary, F. H. Zimmers. The Executive Committee consists of Messrs. Yagle, Schade, Sleeth, McCormick and Thomas.

Before the meeting a thorough inspection of the large and modern works was participated in by some 75 foundrymen. A luncheon was then served, and the regular meeting held. President Slocum addressed the meeting, urging the foundrymen of Pittsburg to attend the meetings and benefit by the interchange of ideas. The Association also received an invitation from the Westinghouse Machine Co. to inspect their new foundry at Trafford City.

The regular meeting of the Association for November was held on the 2nd, Mr. Zimmer, the Secretary, reading the annual report. Resolutions of sympathy were adopted on the death of Major Samuel Hay, a long-time member of the Association. The special thanks of the Association were also voted Mr. W. A. Bole, manager of the Westinghouse Machine Co., for the courtesies extended the Pittsburg foundrymen at the new works in Trafford City during a visit there. Mr. H. E. Field then read a paper on "Economy in Buying, Melting, and Mixing Iron" which was thoroughly discussed at the time, and is given in abstract in another part of this issue, together with some additional matter.

The largest meeting in the history of the Association was held

on Dec. 7. Forty foundries were represented in person. President Slocum was in the chair. Two important papers on Pattern-making were read by Messrs J. C. Warne, of the Penna. Casting & Machine Co., Allegheny, and E. C. Fitzgerald, Supt. of the Manual Training Department of the North School, Pittsburg. These papers are given in full in another part of the issue.

An informal meeting was held on January 4th, the president being ill, and only a small number in attendance. Dr. J. A. Holmes, of the St. Louis Exposition, addressed the meeting on the proposed foundry exhibit. The matter is touched upon in our editorial department, and Pittsburg, as well as Philadelphia, is working hard to make it a success.

PROCEEDINGS OF THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The 130th meeting was held on September 2d, at the Manufacturer's Club, Dr. E. E. Brown presiding in the absence of the President. The treasurer reported $2,114.41 in the treasury, with all bills paid. The committee on the Model Foundry for the St. Louis Exposition reported progress, the number of communications received from intending exhibitors indicating a live interest in the project. Mr. Arthur Simonson read a paper on the "Small Converter Process for making Steel Castings," which was briefly discussed by Messrs. Hibbs and Outerbridge.

The 131st meeting was held on October 7th, President Devlin in the chair. The following nominations were made : For President, Thomas Devlin; Vice President, A. E. Outerbridge, Jr.; Treasurer, Josiah Thompson; Secretary, Howard Evans. For Executive Committee, Thos. M. Eynon, E. E. Brown, R.C.Oliphant, H. O. Evans, T. B. Harkins. For Trustees, Thomas Devlin, Josiah Thompson, Howard Evans. Dr. E. E. Brown reported on behalf of the Committee on the Model Foundry for the St. Louis Exposition, that everything was progressing satisfactorily, and that an advisory committee was forming to get the matter under way. Dr. Richard Moldenke, who was present, also went over the ground and stated that nothing elaborate would be attempted, but that American conditions would be shown with a view of educating the general public and get it to know what a foundry looked like,

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as also to see the various processes involved. The present and probable future of the industry was then taken up and discussed—opinions varying very much according to the temperament and the shop conditions of the speaker. Finally came a paper by Mr. F. Fitzgerald, of Niagara Falls, on the manufacture and uses of Carborundum, which was listened to with much interest.

The 132nd meeting was held on November 4, President Devlin in the chair. The Secretary was instructed to cast one ballot for the gentlemen nominated at the last meeting, who were then declared duly elected. The formation of a "Quiz Class" was next discussed, but action deferred to the next meeting. The Association, by unanimous vote, placed itself on record in favor of a 35 foot minimum depth channel for the Delaware river and harbor. In a discussion of the condition of the foundry trade, it was the consensus of opinion, as reported by the *Iron Age*, that trade was not showing much improvement. There has been a falling off of new business in many instances, and buyers are demanding lower figures for castings, which in some instances have been acceded. There is little encouragement in sight as far as the immediate future is concerned. In the matter of pig iron costs, it was said that many furnaces are now selling iron below cost, but that even present figures would probably work lower. Large buyers have been afraid to take hold in anticipation of reductions, and will not purchase actively until it is fairly certain that bottom has been reached.

The paper before the association for the evening was on the subject, "Penn and His City," by James H. Ritter, of the Biddle Hardware Company, Philadelphia. The paper was illustrated by some fifty lantern slides, and was very interesting from historical, commercial and descriptive points. Mr. Ritter was tendered a vote of thanks at the conclusion of his entertaining paper. The association then adjourned, and the usual lunch was served on the roof garden of the club.

The 133rd regular meeting was held on December 2nd, President Devlin in the chair. Dr. E. E. Brown, of the Committee on the St. Louis Foundry Exhibit, reported on the progress made. Plans prepared by Dr. Edmund A. Engler, president of the Worcester Polytechnic Institute, showing a foundry building, particularly arranged for just such a working exhibit, were shown, and

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after general discussion it was moved that the committee's report be received and they instructed to take the entire matter up with the general committee and decide upon the plan best suited for the purposes, etc. This motion was unanimously passed.

In view of the proposed appointment of commissioners by the United States Government for the construction of the Panama Canal, the association by resolution recommended the appointment of John Birkinbine of Philadelphia, as one of the said commissioners.

The quiz class, a new feature of the association meeting, whereby questions pertaining to the general foundry trade may be asked, which at the next meeting will be answered and discussed, announced for the evening discussion the following subject: "What is meant by 72-hour coke, and how can it be distinguished from other grades?"

Considerable discussion followed. The actual distinction between 72 and 48 hour coke, it was claimed by almost all the speakers, could not be made by observation. Many had used 48-hour coke with as good results as obtained with 72-hour coke. The grade or term, 72-hour coke, was said to be a misnomer, it being rather the care in selecting and cleansing the coke at the ovens that made the grade. Freedom from burnt ends, nigger heads, jammed pieces and coke of a good gray color, are the particular features of the generally termed 72-hour coke, and which is prepared by careful selection and hand picking. Seventy-two hour coke itself was said to be produced only by the custom of running the ovens over Sunday, instead of drawing on that day, the ovens being regulated to burn slower, so that by an excess of air the fixed carbon would not be burned when coking was completed. Chemically, it was contended that coal properly burned, that is to complete coking, whether regulated for 48 or 72 hours' burning, would show no appreciable difference on analysis. "By-product" coke, it was said, which is burned even less than 48 hours and which has everything against it as far as appearance goes, was used with success equal to that when 72-hour coke was used. The usually termed 48-hour coke is largely used by furnaces, while the 72-hour coke is, by reason of its better preparation, used for foundry purposes. It was maintained that it would be far better to distinguish between the two by the terms furnace and foundry coke than the hour term as is the custom in this vicinity.

Another subject proposed was, "What are the advantages of

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loam or dry sand castings over green sand for certain classes of work?" This was explained in the fact that in large and heavy work the body of fluid metal would not "lay" on a green sand surface of a mold, due to the moisture in the sand, etc., while against the dry or loam mold it would "lay" quietly and make a good, sound and clean casting.

The paper of the evening, entitled "Some troubles with samples of iron and coke," was read by Geo. C. Davis, official chemist of the association. It is reviewed in another part of this issue. Mr. Davis also exhibited a number of faulty mail packages just as they had been received by him, and which from contamination of the material for analyses, would have given erroneous results.

H. L. Haldeman of the Pulaski Iron Company said in discussion that foundrymen do not appreciate sufficiently the value of careful sampling. Sulphur and silicon are the chief elements with which the foundryman usually has to contend, and when it is considered that the chemical contents of these elements in pig iron vary in different parts of the same cast of metal from the blast furnace, it is quite necessary a good average sample be taken for analysis to represent the particular lot of iron under examination.

A vote of thanks was tendered Mr. Davis for his excellent paper.

The following subjects were then announced as being proposed to the quiz class, to be discussed at the January meeting of the association:

How many degrees Fahrenheit should an annealing oven be to properly anneal, and how long should material be placed therein?

Does it require more air and greater pressure of blower to melt high numbers of cast iron in a cupola for malleable purposes than it does for ordinary gray iron?

Does it take longer to melt hard white iron for malleable purposes than it does for soft gray iron in a cupola of the same internal diameter?

What causes the change of carbon monoxide gas at the melting point in the cupola to carbon dioxide, above said melting point?

Does high silica facing resist the action of hot steel in steel casting to a greater extent than high carbon facing?

Relative life of brass, galvanized and steel riddles.

Amount of moisture in sand when properly tempered for use.

Relative advantages of exhaust and nonexhaust tumbling barrels for different classes of work.

Are steel castings made by any of the baby Bessemer processes better for certain purposes than those made by the crucible or open hearth processes?

The meeting then adjourned, and the usual lunch was served on the roof garden of the club.

The Iron Age, January 14. The one hundred and thirty-fourth regular meeting of the Philadelphia Foundrymen's Association was held at the Manufacturers' Club, in that city, on Wednesday evening January 6. The president Thomas Devlin, occupied the chair.

The Committee on Foundry Exhibit at the St. Louis Purchase Exhibition reported progress. It was said that subscriptions for space to the amount of $1000 had been received and the Pittsburg Foundrymen's Association had a like amount subscribed. It was, however, the consensus of opinion in a discussion on this matter that the Exhibition Commissioners should erect the building for the foundry exhibit, rather than put this task on the foundrymen and exhibitors, and if the commissioners would do this, there would be no difficulty whatever in getting the foundrymen and foundry supply men to contribute a liberal and creditable display, which would without doubt be one of great interest and education to those visiting the exhibition. The committee report was received, and further matters regarding the exhibit left in their charge.

The paper of the evening on the subject "Side Blow Converters," by N. Lilienberg, was then presented and illustrated by numerous lantern slides, showing both the present day converter and those of obsolete type.

The "Quiz Class" then took up the question, "Does High Silica Facing Resist the Action of Hot Steel in Making Steel Castings to a Greater Degree Than a High Carbon Facing? It was said that high silica facing resisted the action of hot steel, under usual conditions, the best, and that high carbon facings when carelessly applied were very apt to make blisters on the castings.

The other question before the class was, "Are Steel Castings Made by Any of the Baby Bessemer Processes, like the Bookwalter, Tropenas, Stoughton or Evans-Wills Process, Better for Certain Purposes than Steel Castings Made by the Crucible or Open Hearth Process?" No discussion was held on this question, inasmuch as Mr. Lilienberg's paper on "Side Blow Converters," previously read, had gone into this matter in considerable detail.

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NEW ENGLAND FOUNDRYMEN'S ASSOCIATION.

The Iron Age, October 22. The October meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, on Wednesday of last week. Previous to the meeting the party went out to Hyde Park as the guests of the B. F. Sturtevant Company, to look over that company's new plant, especially the foundry, which is now in operation. The company provided barges for conveying their visitors to and from the railroad station, and extended every opportunity for inspecting the foundry, pattern shop and flask shop in all their details. All pronounced the plant a model one.

The meeting was called to order at 5 o'clock in the reception room of the Exchange Club, with President Henry A. Carpenter of Providence, R. I.; in the chair. New members were elected as follows: American-British Mfg. Company, Providence; B. Nicoll & Co., New York; Pevey Bros., Lowell, Mass.; Taunton Locomotive Mfg. Company, Taunton, Mass.; Howard & Bullough American Machine Company, Ltd., Pawtucket, R. I. The membership of Walter M. Saunders of Providence, R. I., was transferred to the new firm of Saunders & Franklin, who were indorsed by the association as its chemists, a position previously held by Mr. Saunders.

W. A. Viall of the Brown and Sharpe Mfg. Company of Providence, R. I., gave a talk on an indenture system for core makers' apprenticeship which the company have under advertisement. Mr. Viall explained that the present method of training core makers, without an apprentice system, was unsatisfactory, because oftentimes men leave a concern's employ as soon as they become useful in the coreroom. A discussion followed the reading of the paper. President Carpenter read the form of indenture for core makers' apprentices used by A. Carpenter & Sons' Company of Providence. The discussion was chiefly as to wages to be paid to this class of apprentices.

Arthur Simonson of William Wharton, Jr. & Co., Incorporated, Philadelphia, read a paper on the Tropenas process of steel casting, illustrating the process by lantern slides; after which the usual dinner was served.

John Magee of the Magee Furnace Co., Boston, presented the report of a sub-committee of the association on a proposed labor bureau, to be conducted jointly by the Foundrymen's Association,

the Boston Metal Trades Association and the New England Iron League. A committee consisting of two members from each of these organizations has had a number of meetings, with a view to determining upon the advisibility of establishing a labor bureau, to cover at its beginning the city of Boston and neighboring cities and towns, and to be extended gradualy as expediency makes it possible until the whole of New England is included. The plan is to take the various branches of the iron business—molders, core makers, pattern makers machinists, boiler makers, blacksmiths, etc. No definite action was taken, but there seems to be a probability that the plan will be carried out.

The Iron Trade Review, December 17. The December meeting of the New England Foundrymen's Association was held Wednesday evening Dec. 9, at the rooms of the Exchange Club, Batterymarch and Milk streets, Boston; with the president, Henry A. Carpenter, in the chair. About 70 persons were present. Applications for membership were received from the Waltham Foundry Co; Waltham, Mass., and from the G. W. & F. Smith Iron Co., of Boston.

The following persons were nominated for officers for the ensuing year, a new name being presented for president in view of Mr. Carpenter's declination of further official service :

President—B. M. Shaw, Walker-Pratt Mfg.Co.

Vice-President—John Magee, Magee Furnace Co.

Secretary—Fred F. Stockwell, Barbour-Stockwell Co.

Treasurer—George H. Lincoln, Geo. H. Lincoln & Co.

Executive Committee of five to be selected from the following: W. B. Snow, B. F. Sturtevant Co.; R. D. Reed, H. B. Smith Co.; J. O. Henshaw, N. S. Bartlett & Co.; A. J. Miller, Jr., Whitehead Bros. Co.; W. C. Doherty, Doherty Bros.; J. F. Lanigan, Davis Foundry Co.; R. C. Cunningham, Deane Steam Pump Co.; W. H. Bense, Kinsley Iron & Machine Co.; Harry Gibby, Condor Iron Foundry.

The afternoon paper was by Edgar S. Cook, president and general manager of the Warwick Iron & Steel Co., Pottstown, Pa. His subject was "The Transition from 'Rule of Thumb' to the Application of Scientific Methods in the Management of Blast Furnaces." Mr. Cook traced the advance in blast furnace operations from the old regime of uncertainty to the present-day practice

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which insured greater regularity of output and consequently assisted greatly toward relieving foundrymen from many irregularities to which uneven working of blast furnaces subjected them.

Archer Brown, of Rogers, Brown & Co., New York, made the address of the evening on "Booms and Reactions in Iron," a subject on which Mr. Brown has written not a little in connection with the developments of the past 6 or 8 years in the iron trade.

PROCEEDINGS OF THE GERMAN FOUNDRYMEN'S ASSOCIATION.

Eisenzeitung, September 24, *et seq*. reports the proceedings of the German Foundrymen's Association which took place in Cassel September 16 to 19. It was a well attended meeting and showed plainly the value of concerted action to overcome difficulties which beset the individual producer. So far as the state of trade is concerned, those foundrymen who make hardware and other merchantable castings in Germany, cannot complain. The makers of structural and machinery castings, however, let loose a wail of distress. As a consequence a resolution was passed urging a general increase in the selling price of castings. Prices, which form the chief topic of these meetings, could not be discussed at such length here, all attempts along such lines resulting in failure. Over there they seem to have better success with agreements and combinations. Labor matters were taken up next, the usual complaints coming in. The trusts were handled roughly, pig iron and coke over there being controlled almost absolutely by combinations. The breakage question, as affecting rail road transportation, has reached a better stage, though still far from being satisfactory. Private insurance companies now being allowed to insure goods in transit. Hamburg was selected as the next meeting place. Then came the papers for the occasion. We are glad to state that following American precedent, this association is devoting more and more time to the technical side of the foundry industry, and it may be added, is doing more than we are over here in the way of financially aiding investigators in the solution of definite problems. They also have to complain in Europe of the apathy of founders in answering circular letters of inquiry, which would throw much light on questions of daily practice. Nevertheless, the work laid out is being carried out faithfully, our member, Prof. Dr. F. Wuest, being especially conspicuous therein. In addition Privy Councillor Juengst and Director Reusch are also active, and we shall hear

more of foundry advance in Germany as a consequence. The lectures by these gentlemen will be reviewed in another place, and will prove of much interest to us. The commission for testing cast iron reported progress and is also working with the International Association committee for that purpose. The topics discussed by Prof. Wuest were as follows:—Effect of silicon and carbon on iron. Composition and physical properties of cylinder iron. The cupola with or without a fore-hearth? Manganese ore for desulphurization in the cupola process. Changes in cast iron due to prolonged annealing. Economy of the crucible furnace. These certainly are weighty problems, and would mean much labor and expense in their solution. In the social side of the convention much that was lively, and much that was sober was brought forth. The labor question was especially ventilated by the veteran, Mr. Bueck, who urged the closest association to counteract the demoralizing influence of unionism on Germany's industries.

PROCEEDINGS OF THE MILWAUKEE FOUNDRYMEN'S ASSOCIATION.

Iron Trade Review, January 14. After the regular meeting of the Milwaukee Foundrymen's Association in the club room of the Pfister Hotel, an informal dinner was given to the foundrymen of the city, and hereafter this will be an annual affair. W. J. Turner, president of the Western Malleable & Gray Iron Mfg. Co., was chairman and toastmaster of the evening. The program included addresses on the subjects named by the following gentlemen. "The National Founders' Association," Irving H. Reynolds; "American Foundrymen's Association," Charles E. Sammond; "Milwaukee Foundrymen's Association," Thos. W. Sheriffs; "National Association of Manufacturers," Frederick W. Sivyer; "The Employer's Rights," A. J. Lindemann; "The Next Molder's Agreement," O. W. Greenslade. A paper prepared by Capt. I. M. Bean, of the Northwestern Iron Co., Mayville, Wis., on "The Business Situation," was read by Fred M. Prescott in the former's absence.

The dinner was given largely for the purpose of bringing the foundrymen of the city together for an interchange of ideas and with the hope of augmenting the membership of the association which still lacked the names of a number of the local founders. It was largely attended, representatives being present from nearly every foundry in the city.

At the business session previous to the banquet, Walter Reed, president of the Filer & Stowell Mfg. Co., was elected president of the association to fill out the unexpired term of T. J. Neacy, of the same company, who resigned. W. J. Fairbairn, secretary of the Metal Trades and Founders' bureau of Milwaukee, was elected secretary to succeed T. W. Sheriffs, resigned.

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MOLDING

Edited by THOMAS D. WEST, Sharpsville, Penna.

Questions, comment and criticism are invited. Kindly direct all correspondence for this department to Mr. West.
The Instruction Papers of this department are sold at the uniform price of ten cents a copy. Founders and others desiring them in quantity can get them at $2.00 per hundred. Send remittances to American Foundrymen's Association, P. O. Box 432, New York City for prompt shipment.

INSTRUCTION IN MOLDING AND CUPOLA WORK.

By THOMAS D. WEST.

PART 2.

Shoveling and riddling sand.

As a rule the first thing an apprentice or laborer has to learn in the foundry is to properly shovel and riddle sand. This may be thought quite simple and easily acquired, but it takes considerable time and patience to become proficient in the art. The proof of perfection in shoveling in the foundry is a well-mixed sand heap. When ready for use it is as shown in E, Fig. 1.

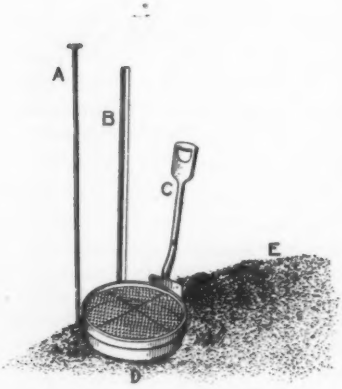

Fig. 1.

Fig. 3.

Wetting down sand heaps.

Before starting to mix up a sand heap, we must first remove the castings in it coming from the previous mixing, as shown in

Fig. 2. The Castings F have been removed to the pile G. The next operation is the wetting down of the dried sand, using a pail,

Fig. 2.

sprinkling pot, or hose. The novice, unless he be supplied with a sprinkling pot, will do this as shown in Fig. 3, while the method of

Fig. 4.

the skilled hand is seen in Figs. 4 and 5. By throwing water as in Fig. 3, a large body of sand is made to mud, a state which makes it difficult and impracticable to obtain a uniformly tempered sand heap. The term "tempering" means mixing, and is a term used by the trade.

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By throwing the water as in Figs. 4 and 5, very little, if any, of the sand is made to mud, the dampening being more of the

Fig. 5.

nature of the final tempering wanted for the whole heap. The sprinkling, or spreading action, distributes the water over greater areas, not enough of it falling at any one place, especially where there are depressions wnich would otherwise hold the water.

A careful molder or laborer will first level up the sand piles as at H, Fig. 6, and not leave them as at I, where deep holes will

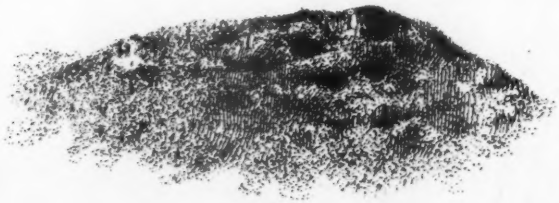

Fig. 6.

catch the water. And yet many a molder, not to speak of novices, will throw whole pails of water into such depressions, making mud.

Cutting or chopping sand heaps.

After a flat body of dried sand from which the castings have been taken (Fig. 2) has had its surface dampened Fig. 4 and 5) as deeply as the water will soak in without forming mud, it may be

best, to save labor, to give the surface body of some 2 or 3 inches deep a "cut" as shown in Fig. 8. (A cut is the technical term for a complete turning over of a body of sand with the shovel.) Instead of cutting the sand thus, the face body may be chopped, or

Fig. 7.

opened with the blade of the shovel at short intervals, to appear as at J, Fig. 7, after which water is again sprinkled on to increase the

Fig. 8.

dampening effect without, however, making mud. This surface cutting or chopping is found most necessary in the finer grades of molding sand. Where the sand is very coarse, the water may penetrate a foot or more without forming mud.

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Skill in using the shovel.

After the face body of the sand has been dampened as deeply as possible by the above method, the pile is then ready for a complete cutting or turning over. In doing this the shovel should be handled in such a way that the sand will be caused to leave it in a scattered form, as seen in Fig. 8, and not as a solid body, shown

Fig. 9.

Fig. 12.

Fig. 10.

in Fig. 9, which illustrates the way a novice or careless molder performs the operation. A study of the two illustrations will quickly

bring out the advantage of handling the shovel to scatter the sand, the only proper method, instead of throwing it as one would sand out of the pit to the car.

It requires considerable practice to scatter the sand thus properly. It is all done by the turn of the wrist, as at K, Fig. 10, the dotted line L showing the extent of the twist movement. By constant practice one becomes so accustomed to this movement, that it is done unconsciously thereafter, in handling the shovel.

Not only must one learn to twist the shovel properly, but to shovel right and left handed, so that either side of the sand heap

Fig. 11.

may be taken, in changing sides singly, or doubling up as in M and N, Fig. 11. To shovel as well on one side as on the other requires more practice than merely to twist the hand, and indeed there are some molders who have never acquired this habit sufficiently to be proficient. Then again one may learn to do this very well, and lose the art if the practice is not kept up constantly. It is an interesting sight to see two well skilled shovelers change sides, or work right and left handed, resting themselves in continuing active work, and making larger sand piles more perfectly mixed in a stated time, than can be done by less experienced hands.

Methods for mixing and forming sand heaps.

It is of the utmost importance to keep a line of division between a sand heap which has been cut, and one which is to be. This is seen in Fig. 11, at P, where there is a space between the

sand mount O, which has been cut, and Q which is still to be cut. The difference between a skillful molder and one less experienced can be seen by the way his sand heap is thus treated as forcibly as in any of the other workings in mixing sand. No part of the sand heap should escape being "cut."

Occasionally one witnesses the mixing of sand by supposed molders which reminds of laborers mixing mortar, or bakers kneading bread. It is a question whether the feet or hands do most. More awkwardness is exhibited in this direction in the foundry than in any other. To the man who wishes to be considered most proficient, let it be said that the art of mixing sand must be just as perfectly acquired as any other in the foundry.

Number of "cuttings" a sand heap requires.

This will depend upon the dryness of the sand and its nature. As a rule two cuttings should give a uniformly tempered sand heap.

Fig. 13.

The sand is usually wet down in the first dampening, after the castings have been taken out, Fig 2, to nearly the final dampness required, experience being the best guide in getting the right temper. After the first "cut over" the molder feels his sand at different parts of the heap, and any portion too dry will be sprinkled over to give the necessary degree of "temper" required. After this operation the heap is again cut over and left in shape for filling the flasks or forming molds, as seen in fig. 1.

It is just possible that an error in judgment may have been

made in wetting down the sand, so that it turns out too wet, or too dry, at the second cutting. In such cases, if too dry, more water should be sprinkled on, as seen in fig. 5. If too wet, on the other hand, dry sand is secured from other quarters and scattered over the heap, after which a third cutting will be found necessary. Where the sprinkling of water, or scattering of dry sand is but light, the third cutting of the sand heap is often omitted, and the sand used by chopping the heap as it is consumed.

The tools of the molder are seen in fig. 1, which shows the rammer, strike, shovel, and riddle in the order given.

Degree of dampness necessary in sand heaps.

The degree of dampness necessary for sand heaps is a matter difficult of description. It depends upon the nature of the sands, the character of the castings to be made, etc. It will be gone into

Fig. 14.

more at length when taking up the ramming up of bottom, sides, and top of molds that are capable of definite description.

In a general way it may be said that a tempered sand heap should be of such a degree of dampness, that by taking a hand full and squeezing it, the lump made should stand holding between the fingers as at R, fig. 12. The best "temper" point for the compressed sand hanging as at R, is found above the dampness generally best for ramming molds. If sand is too damp, it will break or drop from the hold by the fingers as at S, fig. 13 nearly as quickly as when too dry. A fair proportion of loam in the sand gives it

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the best opportunity of holding dampness. The more loam, the greater the strength of the sand.

Renewing and testing the strength of the old sand.

In tempering the used sand heaps, more or less new sand is added to renew its strength. This is generally done by spreading the new sand over the old after the heap is wet down for the first time, or on the heap after the first cutting. A heap renewed regularly with fresh sand to keep its life up to a good standard, may be sustained between the fingers (as at R) much easier than old sand not so renewed.

The experienced molder can judge the "temper" of the sand by merely squeezing it in the ball of the hand. In fact he can closely judge it when passing by, and should he think it wrong he will test it to make sure his eye did not deceive him.

Fig. 15.

Methods for using stiff shovels.

In the foregoing description, the tempering of sand on the floor for "rolling over" work has been specially kept in mind. We must now take up the subject of digging out holes and mixing the sand for "bedding in" work. Here we chiefly make use of the stiff shovel, which requires skill just as much as the use of the flat, or molder's shovel. Because it is a stiff shovel, one must not use it as if digging a ditch or turning up sods. In digging out cold or hot holes, or tossing sand a distance in a body, as shown in fig. 9, with a stiff shovel, the expert molder does not like to be

caught in the position shown in figs. 14 and 15. He will strive to hold the shovel free to work as in fig. 16, and only assume the position of the sod or sewer digger when the sand is packed so hard that he cannot shovel it otherwise. The novice would natur-

Fig. 16.

ally not do it otherwise than as seen in fig. 15. This is the attitude of the lazy man, something the expert molder has no sympathy

Fig. 17.

for as he himself must be more or less of an acrobat. The heavy

work molder must be just as much at home on his back, stomach or knees, as on his feet.

Importance and methods for keeping shovels clean.

The subject of mixing sand would be incomplete were we to neglect the question of cleaning shovels. It is astonishing to note the number, even of experienced molders, who work with dirty shovels. When one sees a man working with a shovel incrusted to a thickness of ¼" with caked dirt, and laboring with might and

Fig. 18

main as the sweat rolls down his body, while mixing a pile of sand. And when one suggests to such a man that if he cleans his shovel his work will be easier, a look of wonderment will be noted which makes it appear as if some great secret has been imparted. The difference in labor as between using a clean and a dirty shovel is surprising. A little time taken to scrape off the dirt with a thin wedge of wood, as at Fig. 17, T, and then rubbing on a thin coat of oil or grease will do wonders, and make the mixing of the sand heaps fully half as light.

Correct and incorrect ways of handling the riddle.

A riddle is a sieve with its meshes over ⅛" square. A ¼" riddle means that the spaces between the wires are ¼" square, and so on through the numbers given.

The novice will be fully as awkward with the riddle as he is with the shovel. He will grasp the rim for dear life, and when at work appears something like Fig. 18. The correct way of holding this tool

is to let it play loosely between the second joint of the fingers as in Fig. 19, so that the butt of the hand may have a free chance to strike the rim, as at U, alternately with every swing of the arm

Fig. 19.

(shown in dotted lines below V). The sand being shaken out and seen falling at W.

To rest the muscles, the motion can be changed to swing

Fig. 20.

to and from the body, as shown by the dotted line below the riddle at X, Fig. 20. This is only to be used as a relaxation, how-

ever, as one cannot do much effective riddling that way, as by the method in Fig. 19.

To assist the riddling, two or three ¾″ to 1″ round rods may be laid along the bottom or on the wire meshes. These are made to roll around by the motion and assist in breaking up the lumps,

Fig. 21.

the crushed sand dropping through the riddle or sieve. In place of these rods a wooden block 2″ by 2″ by 5″ long may be used to rub the lumps as shown in Fig. 21, at Y.

In sieving sand, the meshes are very liable to become closed by gumming up, and thus greatly, if not wholly retard the operation. Before this state of affairs comes to pass, the sieve should be cleaned. This can often be accomplished by striking the rim on something solid, as at Z, Fig. 22, or by scratching the wires with a wire brush. Where very fine sieving is required, and the sand is of a gummy nature, or very damp, it often becomes necessary to dry the wires of the sieve over a hot stove or coals.

The care of sieves and riddles, and the disposal of screenings.

When not using the sieves or riddles, and if left on the floor, they should always be placed with the wire mesh upward, as at E, Fig. 1, for if left the reverse way, the wires on the damp sand, the meshes become clogged and the sand refuses to pass through them easily. They should always be hung up, when through with for the day, or placed on a shelf in a dry place. Where the wires are of brass, dampness will not affect them as much as if of iron; never-

the-less they should have a place where they can be found when wanted.

When sieving or riddling, there will always remain more or less screenings that must be cared for. These should not be thrown at any old place, until the locality looks like a back-yard dumping ground. There is nothing worse about a foundry than a lot of

Fig. 22.

screenings left about by careless men. They make the place look slovenly, and eventually affect the men similarly. The molder who takes pride in his work will see that a barrel or other receptacle is provided in the gangway, and that at the end of the day, or when occasion serves best, all this material is removed, and his floor and surrounding remains neat and orderly.

THE BOTTOM OF A GREEN SAND MOLD.*

By THOS. D. WEST.

Following incorrect lines in forming the bottom part of green sand molds is to be seen in nearly every foundry. When molders are left to follow their own ideas, it is uncommon to find two working on the same lines.

Before proceeding to illustrate methods commonly practiced, it

* Read before the New England Foundrymen's Association, November 11, 1903.

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will be best to define principles involved in the right construction of mold bottoms or beds.

Two of the first lessons we learn when engaging in the art of founding, is that molten iron will not lie quietly upon dense damp or rusty bodies, and that it exerts pressure according to the height of its head or column, similar to water or other fluids. The way some molders work would lead one to believe that these fundamental principles were only discoverable after many years of sad experiences. Having knowledge of the fact that molten iron will not lie quietly upon dense damp bodies, and that as height of head increases, so does pressure, we have the foundation of intelligent manipulation in making mold bottoms or beds. In stating these principles we have first to ask, why will molten iron not lie quietly upon dense damp bodies? It is because the metal's heat creates a steam, which will escape the road of the least resistance, and this as a rule is up through the molten metal when poured into rammed molds. This escape may be of a mild character or so violent as to not only to cause scabs, etc., on a casting but blow the metal in a mold so much as to make what is left of a casting nearly unrecognizable. In considering head pressure we have but to recognize the fact that with equal pressure of metal we must have equal density or hardness of mold body under it, if we wish the bottom of a casting to be true to its pattern.

Having briefly considered the effects of steam and pressure, it is next in order to treat of the effects of their combination and the conditions which should prevail to best counteract their evils in constructing mold bottoms. The dampness or "temper" is controlled by molders generally much better than the density. The chief trouble lies in obtaining a proper and uniform density. The ideal density lies in having the face of a mold the softest and the under body sufficiently hard or solid to withstand the head pressure or strains that will be exerted upon it when the mold is poured, and which if not uniform can cause thin castings to warp or crack, due to disarranged or unequal thickness, or heavy ones to have swells on the bottoms, or give way so as to cause burst-outs and lose castings.

To overcome evils of dampness and density, we resort to venting. This can often prevent the injury that errors in "tempering" and ramming sand can cause, provided it is done intelligently. While venting is a necessity with most all kinds of bottoms, except-

ing with most "open sand" work, there is a limit to its utility. Venting cannot prevent ill results where the surface sand is excessively damp, fine, or is rammed too hard. We can ram the under body of a bottom excessively hard and all will work well if it is well vented and the surface is of open sand, dry as can be worked and sufficiently soft. As a rule the damper or finer the sand, or harder the ramming, the more venting required. This leads to the inquiry, how damp should sand be mixed, how fine should it be used, and what degree of hardness is desirable?

Comparison of Compression in Dry and Wet Sands.

The drier the sand can be used the better, as the drier the sand the less steam created to cause trouble and labor in venting. Dampness is required wholly for the purpose of maintaining forms, affording an opportunity to finish them and to prevent the rush of flowing metal washing away the sand. Excepting the first inch or two of the surface, the bottom of some molds could be sustained with sand in a dry powdered state, were the sand sufficiently coarse to admit the downward escape of the steam that would be generated from the damp surface sand. On account of the inconvenience of using all dry sand and the risk of the damp surfaces parting from it during the action of pouring, damp sand is used for the under body, as well as for the surface. A study of this point will show that the degree of dampness necessary for the hard body under the surface was only such as would be sufficient to allow the sand to pack solid and hold the form of vent holes, as it can be readily seen that if a vent wire was passed through a body of dry sand or dust, the hole left by the removal of the wire would fill up with sand, just as if the wire was passed in and out of a body of water.

Another factor to be considered in connection with the point just raised is that dampening sand has the effect, up to a certain limit, of decreasing its density, so that in using the "tempered" or mixed sand, as in the ordinary green sand mold, it must be rammed in order to transform it back to something of the density that exists when the sand is in a dry state. If we dampen the sand to the degree of making a mud, then we again effect a density much nearer to what exists when sand is in a dry state. In other words dry sand packs itself similarly to mud; whereas when it is in the mean state between dust and mud we must ram it to obtain a similar density. I have found by tests that I made for this paper, that a pail full of sieved loose tempered sand can be rammed down about

3 inches while a pail of sieved dry sand will go down by ramming but about 1 inch. The same sand made into mud cannot be depressed or rammed down to any perceptible degree: Then again a pail of the same sieved dry sand tempered suitable to ram molds will fill the pail 1½ times, whereas when in a mud state it will equal closely the space taken up with dry sand, when packed as closely as it can be rammed.

Fine and Coarse Grades of Sand.

The grade of sand best to use depends chiefly upon the thickness and design of castings. In small plate work, the lighter the castings the finer the sand should be. This is not necessary on the ground of making it practical to produce variation in the thickness of castings or decrease the loss by bad work. There would be less loss of light castings by the use of coarse sands than by fine where the question of smooth and sharp surfaces is ignored, but as this is one of the chief points sought in making light work. sands are used as fine as they can be worked without creating too great a loss in castings by not running full and "blowing" to make unsound or rough surfaces.

Smoothness and sharpness of face in light castings is chiefly dependant upon the character of sand used. It is surprising the difference in smoothness and in obtaining sharp, clean, full indentations that is produced by different sands.

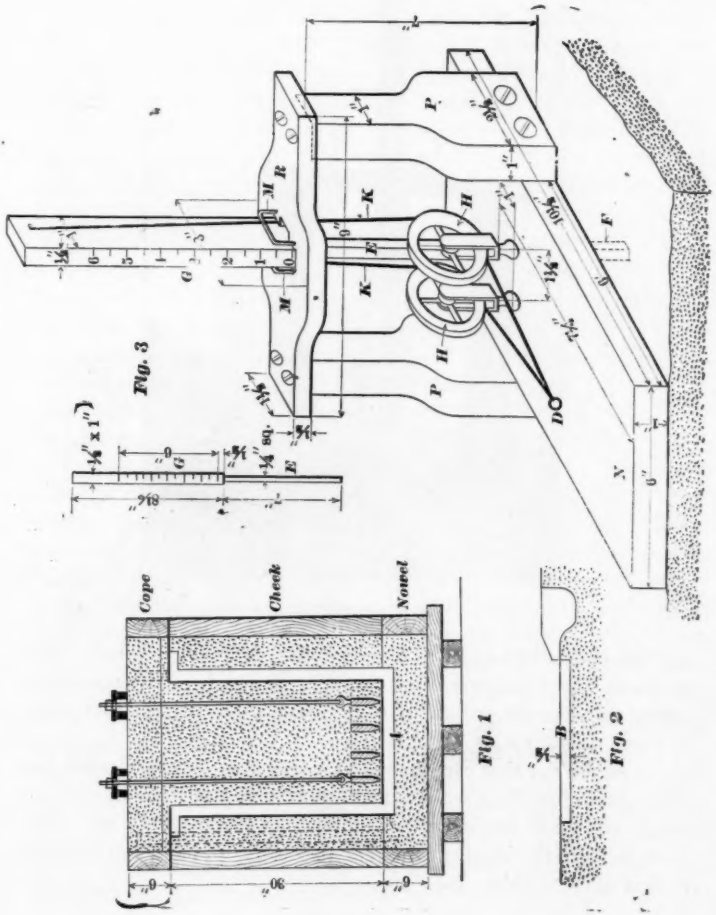
Coarse grades of sand are necessary for heavy work, chiefly on account of the thicker bodies of metal creating extra gases, which must have a freer exit than fine grades of sand can give. By extra skill, care and labor, fine sands may often be used with the result as in light castings of giving smoother surfaces, etc., but in many classes of very heavy castings or complicated light ones, the chances of blowing, scabs and total losses would be so great as to make it unwise to attempt their adoption.

There is a great difference in the physical character of sands. Some localities will produce a character of sand that cannot be found in any other section of the country. The foundry that has the best sand to be found for its work in its own locality is in luck. There are few things more harassing to molders and management than being compelled to work with inferior sands.

Testing of Degrees in Hardness of Rammed Sand.

The density or hardness that is best for the face and under body of a mold bottom may be said to be due chiefly to the speed

of pouring and the head pressure of the metal, the extreme of which can be demonstrated in the making of a bottom for a deep pot with a 36-inch head and an open sand plate with a head of ½ inch, as seen in Figs. 1 and 2. In ramming the bottom A for the pot it must be made very hard or of such a density as would be penetrated ½ inch with a pull of 25 pounds by the hardness testing device seen at Fig. 3, and to be described later on, whereas with the "open



sand" plate B, Fig. 2, it required but a pull of 2 pounds to penetrate through the packed surface to the under body of soft sand.

The extremes of hardness presented by Figs. 1 and 2 illustrate the wide variation that exists in demanding different degrees of

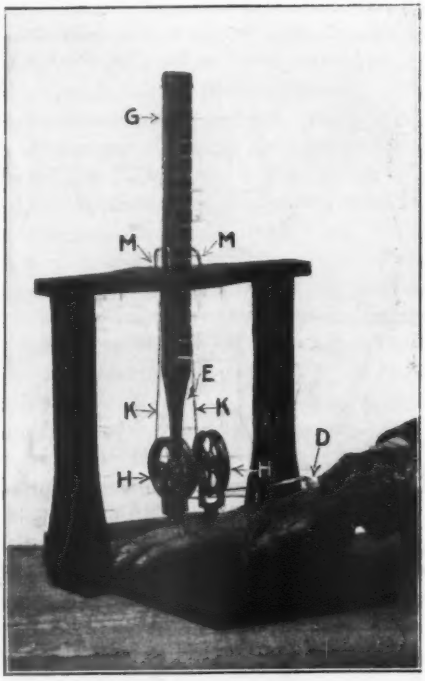


Fig. 4.

hardness and displays in a measure the delicacy of touch, high skill and sound judgment that founding demands of the man competent to make the great variety of green sand castings that exists in many foundries.

The molder that can change from any one job to another and make perfect castings without making from two to three or more to obtain one good one is worthy the name of artist, for in no other trade is there the high exaction for the work of hand and mind as in that of the molder.

Systematic Plans for Making Bottoms.

Foundries having a large business in different classes of work, have to a greater or less degree, experienced losses in casting and in obtaining imperfect work by reason of unsystematic shop methods and unintelligent workings of molders. These evils should cause us to welcome any means to establish more uniform methods of working. There is no reason why in the making of bottoms greater uniformity of system should not exist. If, in foundries allowing molders to follow their own ideas, duplicate patterns of fire fronts, for example, were distributed to four different molders, we would most likely find one rolling it over, another one resting it on four corners and tucking it up, another sledging it down into a bed of soft sand and another making it on a hard bed. A perfect casting could be produced by either method if made by a careful and skilled molder, but as these are rare, we would more likely not find a perfect casting in the bunch. If, instead of this go-as-you-please plan, each shop would have some established plan that had proven a success for all to follow, there would be a noticeable reduction in bad work. It is not to be expected that all shops would follow like methods, nevertheless these are workings that could be made much more universal than they are. This is especially true in the matter of making bottoms or beds and in which there is great need of some standard test for hardness. In my study to offer something new here that would serve for such a test, I present the device seen in Figs. 3 and 4.

By resting this device upon the face of a mold or above it and pulling on the spring balance as seen at D, the compressor or hardness testing rod E is pressed downward into the bed of sand or bottom at F according to its degree of hardness or density, and which is told by the scale of inches at G and the weight pulled by the steelyards, its limits being in pressing the compressor rod D from the fraction of an inch to 6 inches and pulling the steelyards from one to twenty-five pounds. While the hardness tester is limited to a depth of 6 inches it will be seen that this is sufficient when it is stated that rammed courses rarely exceed this depth.

The sheave wheels H, also the steelyards D can be purchased in most any hardware store. The compressor rod E should be made of hard wood. The strings K should each be strong enough to lift 40 pounds and kept back from getting caught in the compressor rod's guides by little staples as seen at M. The base N,

uprights P and top of R are all made of pine or other soft wood. The construction need not cost over $2.00. With the above explanation and the two views shown, any one should be able to construct a machine. The ideas presented in this device could be embodied in a machine made after the plan of scales by our manufactures and no doubt give a machine better for the purpose than the one shown.

The adoption of such a device as shown in Figs. 3 and 4 should afford the management of many foundries a much better control of the molder's work in making beds or bottoms for both light and heavy work than exists at the present day. Take the case of light plate work, stoves as an example, where it is important to hold a uniform weight in duplicate casting. Here we find the difference in molder's ramming, which can vary greatly in hardness, will make some duplicate castings much harder than others, especially where new men are brought lnto action. The evils arising from having excessive differences in weights need no recital here. Suffice it to say that with a device like Figs. 3 and 4 the management should be able to sustain standards for hardness, so that by the time a new man, or an old one on a new job, had rammed two or three molds he should know how to gauge his ramming to obtain the hardness dəsired and thus avoid the rammlng of 50 or more molds to give undesirable weights, with accompanying losses, before correcting the evil.

In the ease of heavy work we would be enabled to fix standards for hardness that could greatly prevent swells, scabs and other evils to come from un-uniform and incorrect hardness of beds. The more one thinks of the advantages to be gained by having some arrangement whereby standards for hardness could be adopted the more he will perceive its value.

Standard Methods for Making Beds.

There are two classes of beds—soft and hard. There is no doubt more difference displayed in molders doing work in this line than others, although it is a line which greatly admitted of being standardized. To demonstrate the practibility of standardizing the work, I will illustrate plans for making beds (which I have used successfully for many years) in a general manner, avoiding the details in order not to tire the patience of any that may be familiar with such work.

The first work in making a bed after the sand has been tem-

pered is to level the straight edge. This is best done by resting the ends on mounts as at S, and then bring them to a level in the order of Nos. 1, 2 and 3, Fig. 5, after which the space between the mounds S is all filled in and tucked up solidly to look like T, Fig. 6. In Making a soft bed, sand is filled in and struck off to project ⅜ inch to ½ inch above the top of the straight edge as seen at U. This done the projecting body U is knocked down all over the bed with the straight edge V to a level of W and X. On this "open sand" castings ranging from ½ inch to 1½ inches thick can be made. By having the projection U ¾ inch high "open sand" castings 2 inch to 3 inches thick can be made on soft beds without

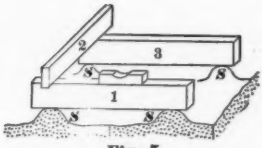


Fig. 5

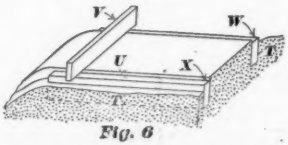


Fig. 6

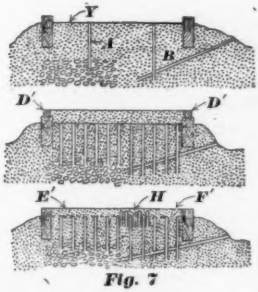


Fig. 7

the use of a vent wire in any manner. This method insures a definite action, and results in obtaining true castings, but instead of all molders following such plans many are more likely to shovel in their sand to a height of 2 inches to 3 inches above the straight edges, and pound its face down with the flat of a shovel, piece of a board, or with the the palm of the hand; methods that are sure to render more or less un-uniformity in the face of a bed and hence give imperfect castings.

In making hard beds we must resort more or less to venting, and success in preventing scabs often depends upon the method of venting practiced. A hard bed can be used for open sand castings as well as coped ones, although as a rule they are used for coped work. A hard bed that will work for "open sand" casting is made by ramming the sand with pein and butt up to the top of the straight edge and striking off the sand within ½ inch to ¾ inch of the top of the straight edges as shown at Y, Fig 7, and then closely venting all the bed down to cinders as at A′ or to connect the

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down vents underneath as at B'. After the bed is all vented, the hand is passed over the vent holes to close their top openings and sand is then shoveled on and struck off ¼ inch above the straight edges as seen at D'. This done the guide strips D' are removed and the projecting sand is then knocked down with a straight edge to the level seen at E. On this we can cast "open sand" plates from 1 inch to 4 inches or more in thickness. For plates under ¾ inch thick the ½ inch to ¾ inch of compressed sand F' would be best vented with a fine wire as at F' to connect with the larger under vents. So much for hard beds for "open sand" castings. In turning to beds for coped work we vary the operation merely by harder ramming of the body Y, varying the distance between Y and the top of the straight edges and also in the thickness of the pieces or thickness D'. By these variations we can obtain any degree of hardness necessary to the work in hand. The contrast to these systematic methods lies in placing go-as-you-please heights of sand, patting it with the hand, tramping it down with the feet or running over the surface with pein and butt, in connection with all styles of careless and unreliable methods of venting, to describe all of which would occupy more than my allotted time.

This paper should demonstrate that there can be systematic methods for making bottoms or beds and in view of the present erratic and bad practices followed in making such, I would suggest some action being taken to have the subject brought before the American Foundrymen's Association with a view to the ultimate adoption by that national body of standards for making beds. This would surely go a long way in causing our molders to work more systematically, lessen the worry of managers and greatly decrease bad work and losses in our foundries.

THE TOP OF A GREEN-SAND MOLD.*

By Thos. D. West, Sharpesville, Pa.

In considering the top or cope side of a green-sand mold we have to deal with the question of supporting bodies of sand properly, the degree of dampness and density of the sand, and the matter of open or closed risers.

To go about suspending sand properly in a cope, we must first

* Read before the New England Foundrymen's Association, November 11, 1903.

know the weight of the rammed sand, and second, the largest body that can be safely suspended between four walls. Tests show that this is 14" x 18" x 4" to 6" thick, the weight being about 100 lbs. to the cubic foot. The deeper the body the greater the area carried. The sand itself has much to do with this, as well as the shape of casting, the bodies extending below the joint to be lifted, and the head pressure of the melted metal requiring consideration.

In cases where the area of copes exceed 14" to 18" square they are sub-divided by what we term "cross bars," and give us what might be considered sub-pockets. These divisions vary in form, the one of greatest utility being oblong, as by this form larger areas can be suspended than by squares ones. As an example, a space 6¾" x 48" can be rammed to far more firmly suspend a

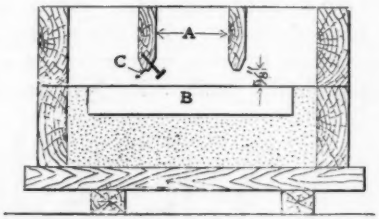

FIG. 1. USE OF CROSS-BARS FOR HOLDING COPE SAND.

body of sand than one of the same area put in the form of 18" x 18". This illustrates a principle in cross baring copes, that if kept in mind, would greatly decrease the number of "drop outs," or the release of suspended bodies in handling copes, or pushing the sand up out of the bars, when moulds were poured to thereby cause bad castings, and often heavy losses.

Utility of Gaggers and Soldiers.

To assist cross bars suspend bodies of sand, we have recourse to what are termed "soldiers" and "gaggers," with which all founders are familiar. When and how these should be used are points that can here be profitably discussed. A "soldier" or "gagger" should be used only in cases where they are necessary to aid suspend bodies of sand, or to assist in preventing the "drawing down" of cope surfaces, as their use is liable to cause an uneven surface, or blow holes, on the cope side of light castings. While

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they are a necessary evil there is much work that demands their use, in fact it is always best to give any doubt of their being necessary the preference.

The question could be asked which is best, "soldiers" or "gaggers." This depends upon conditions, a "soldier" of the same length of a gagger can suspend the greatest body of sand, for the reason that its sides offer greater surface for hanging sand to adhere and that between the bars to be packed against it.

The character of work most largely dispensing with the use of "soldiers" or "gaggers" is such as "stove plate." Here the face of the bars A are evenly chamfered as at C, Fig. 1, and brought within ½" to ¾" of the face of the pattern B. In some cases where inferior sand is used the face of the cross bars may have nails drove into them every 2" to 3" apart on both sides, or one row in the center after the manner seen at C. Some shops other than those making stove plate, etc., adopt this nailing plan in some of its work, in preference to using gaggers. The chief objection to this lies in the projecting nails being hard on the fingers when

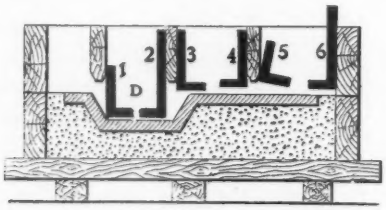

FIG. 2. CORRECT AND INCORRECT USE OF GAGGERS.

"tucking the bars," also in the liability of moulders to neglect the "tucking" on account of the nails hurting their fingers, such neglect will leave soft spots under the bars in the copes surface to cause swells on the castings, if they were not pressed down and filled up with sand when finishing the cope.

In Fig. 2 is displayed a few good and bad practices in setting gaggers. At No. 1 is seen a gagger coming up but a short distance between the cross bars, while at No. 2 it extends the full heighth of the bar. One might think any workman of intelligence would not set gaggers as shown at No. 1, never-the-less moulders can be found most every day in foundries using gaggers, setting

them after the plan shown. A gagger or soldier to be reliable in suspending bodies which protrnde below a joint should extend fully two-thirds its length up between bars as seen at No. 2. One would stand a better chance to lift a body as at D without gaggers than to get them like No. 1, for the simple reason that thes pace occupied by the gagger is heavier than if it was sand, and there is no pressure to hold the gaggers between the bars.

At Nos. 3 and 4 are seen practices followed in setting gaggers on sand sieved or placed over the face of patterns, wherein one is nearer the pattern than the other. Some work intelligently on this while with others it goes as it happens. Where castings are heavy and especially if there is any liability of the sand drawing down, it is generally advisable to have but about ¼ in. thickness of sand under the gaggers, whereas with light or thin castings ½ in. thickness is best, as by this a better chance is afforded the escape of gases and the avoidance of hard spots which often cause defects in the

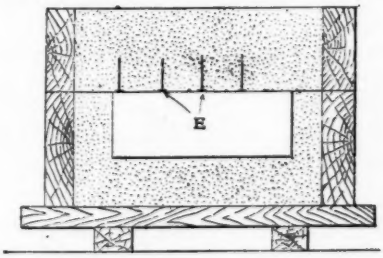

FIG. 3. NAILING COPE SAND.

cope face of thin castings. These are also often caused by the careless practice many follow of setting gaggers having a lot of flour paste or tumps of clay sticking to the toe of gaggers when setting them onto the sand covering the face of the pattern. This causes mud spots that readily produce defects in the cope surfaces of their castings. If proprietors and managers would notice these points in their passage through foundries to let moulders know they knew what was bad practice in this line, there would be far less bad work due to their ignorant or careless practices.

Dampness in Sand for Ramming Copes.

There is considerable difference in the treatment of sand required for ramming copes than in forming the bottoms of moulds. One peculiarity lies in the difference of freedom for the escape of

steam, and which can be illustrated in a radical manner by imagining the different results in pouring molten iron into a ladle having water on its bottom and by pouring water on top of a ladle of metal. In the first case we would have an explosion that would shake the earth and scatter the metal in all directions, and in the other case no evil results other than a free harmless espape of steam and a little dulling of the metals surface. This is so harmless that often when in a hurry to cool off the metal in crane ladles, to get the right temperature for casting, I pour one or more pails of water on top of the metal. The only thing to guard against in doing this is not to press the chilled crust under the molten metal to melt it before all signs of dampness on the surface of the crust has disappeared. It is not to be understood by this that we can in all cases have

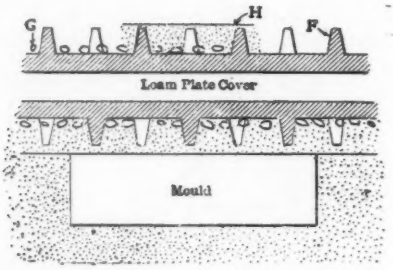

FIG. 4. A LOAM PLATE COVER.

the top surface of moulds excessively damp or approaching a muddy condition. There are cases however when we require the extreme of dry and wet sands more than in the formation of bottoms. These extremes are to be found in light and heavy work, and are due in the case of light work to the sudden contact of metal against a large surface, while in the case of heavy work it is due to the exposure of large suspended surfaces to high heat. To illustrate the first we will take the case of large boiler fronts. In pouring such castings the metal must as a rule be rushed in with all speed practical, and in castings over ¼ in. thick the metal flows over the bottom in a thin sheet until it is all covered, it then raises in a fairly uniform body until it strikes the cope's surface and pops up the risers to denote the mould is filled. The filling of such molds and lighter ones is so sudden there is little time given for the escape of

steam or gases, and hence there is greater need of precaution in preventing their creation and providing means for the free liberation of what may be formed.

When the gases are excessive and confined, we experience defects in the cope surfaces of light castings, much more so than in medium or heavy ones. These defects may be in the form of wavy rough surfaces, smooth concave indentation, corners, edges and plain parts not running full to the shape of the pattern, and "cold shuts." These defects are caused by the steam or gases forming a cushion between the mould and metal, and are aided by metal being dull. The hotter the metal the longer time afforded the gasses to escape before the metal setts or solidifies. To avoid these defects we must use the sand as dry as possible, ram it after the manner to be shown and use the vent wire freely in connection with having good hot metal.

Drawing Down of and Skin Drying Copes.

Having shown the necessity for using sand as dry as practicable we will now show wherein the reverse is advisable, and which lies in the making of heavy castings having large cope areas that will be exposed to the direct heat of metal during the time a mould is being filled. Take the case for instance of making a casting 4 in. to 6 in. thick by five or more feet square. Here, from the time we start pouring until the mould is filled, which can range from one to four minutes, the top of the mould is exposed to the intense heat of the rising metal, and should a mould be poured short to wait for iron, it might be exposed from five to fifteen minutes. A conception of the heat which such cope tops have to stand can be had by considering how a flat body of green sand would be effected were it suspended a few inches above the surface of a large ladle of hot metal. It will be evident that the heat from such a body must be very effective in drying the surface sand exposed to the heat of the metal. This is found to be the case in the daily practice of making heavy castings, and has resulted in causing much bad work and in originating the technical term "drawing down," which in a literal sense is the dropping down of sand that has been dried by the heat. Moulders without experience in making heavy castings, have upon starting to do so found the top surface of their casting to come out with large flat lumps on them, and the sand which came from these places floated off to form depressions or cavities in other sections. Some molders have gone on making casting after casting and be

unable to remedy such defects. These flaws in some cases would send the castings to the scrap pile and cause heavy losses. To overcome this evil the sand used for the first inch or so on the top face of the mould must be of such a character, that instead of the intense heat drying it to a dust form, it will bake it to form a hard crust, that by being closely gagged or surfaced nailed as at E, Fig. 3, will not separate from the damp sand above its surface. To achieve this the sand used should be of a loamy or clayey nature, such as will bake hard when heated. Some localities can obtain sand that is suitable without mixture with any material for this work, while others must mix flour or clay wash with their sand in order to obtain a facing that will bake when heated. As a rule all such facing sand must be made much damper than that used for light castings, and aside from starting with a much damper sand, it is often a good plan in case of very thick castings or those exposing the top or cope surface over one minute to the heat of the rising metal to dampen the finished cope surface with water, or better still, mixing half a pint of molasses to about two or three gallons of water, by means of blowing it on with a sprayer or brush. The surface can in that manner approach a mud and will work all right for very thick plate casting long in pouring, but which if attempted for light or quickly filled moulds would cause a boil or explosion that would throw most of the iron out of the mould and endanger the workmen.

Another plan often adopted is to "skin dry" the top, or to use a loam plate covering. The first is obtained by making the facing of strong loam sand or mixing weaker sands with flour or clay wash and wetting the rammed or finished surface to make it very damp for a depth of ½ in. or so and then building a fire under the cope with shavings and fine wood or gas to "skin dry" the surface to a depth of ½ to ¾ in. This is done chiefly where the cope's surface is to be exposed a long time in pouring, or where sands are very weak and the mould will be filled quickly, the former causing fear of the sand "drawing down," and the latter because if it was left damp or of a loamy nature there would not be time for the rising metal to dry the surface sufficiently to prevent the metal boiling and make defects or a bad casting. In such cases it is often best to surface nail the copes as at E, Fig. 3, in conjunction with the setting of gaggers, as with the use of weak sands there is great danger of the "skin dried" thickness parting from the green or un-

dried upper body of the sand and by surface nailing the dry and green are held together.

Loam plate covering is used only in copes for massive castings, or those long in filling, where best assurance of preventing "drawing down" is desired. This is made by casting plates with prickers as at F, Fig. 4, and after covering the surface with fine cinders as at G, the cinders are then wet with clay wash and a strong mixture of loam, wet to a mud state is then packed on as at E, after which the whole is thoroughly dried in an oven or otherwise.

Density of Sand in Rammed Copes.

In ramming copes, we have much the same conditions to contend with that are found in bottoms. A cope 6 to 8 in. deep is best rammed by making two courses. The first course should not be over 4 in. deep, and the ramming of it by the pein should be done in a regular, close, even manner, so that all its surface will be alike in density. The second course of sand is first rammed by the pein and then by the butt. The second peining can be done in about half the time required for the first course, all that is necessary is to press the pein down solidly to feel the first course in spaces 2 to 3 in. apart, whereas the first course requires all parts of its body penetrated with the pein. After the second peining the butt end of the rammer is used, and upon this dependance must be most largely placed for obtaining the density necessary to maintain the sand between the cross bars while handling the cope and pouring the mould. Some in ramming copes under 8 in. deep will avoid the second peining by putting in the greater depth of sand for the first peining and finishing with the butt. With copes 4 to 6 in. deep this may often answer, but with those of 6 to 8 in. deep the plan is not, as a rule, a desirable one to follow, as it does not afford the chance of obtaining the even density or degree of hardness of the face secured by the two peining.

To hold the sand reliably in a cope, the butting is of the greatest utility, It not only packs the sand most solid, but also saves time and labor. As a rule it is used but once, no matter how deep the cope, or the deeper the cope, the more courses of peining, reserving the butting as a rule for the last course.

The surface of light work copes should be softer than with heavy work, anc either class will require harder ramming on the face to a certain limit, according to the heighth of head pressure is to increase in pouring the mould. Two thin castings having the

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same density of cope surface, but one having a higher head pressure than the other, would differ in thickness, although made off from the same pattern.

Methods of Venting and kinds of Vent Wires Used.

The method used for venting copes are regulated by the density and dampness of the sand, also class of work being made. Light work copes, as a rule, should for plain plate work have the vent wire pushed close to the surface and not over 1 in. apart, while with heavy plain plate work, the vents are best kept within ½ in. of the surface and many range from 2 to 3 in. apart. Where there are projections of any character closer venting will be required in heavy as well as light work. The advantages of close and distant venting will be understood when one considers the reason given herein for the liberation of gases.

The size of vent wires used range from ⅛ to 5-16 in., the larger wire being used for hevay work and the deeper the venting or cope the larger wire necessary. A feature that will strike some as being unscientific, and will be new to many, lies in the difference seen in the points of the vent wire at Fig. 5. A novice in their use would select K as the one to offer the least resistance to force when being

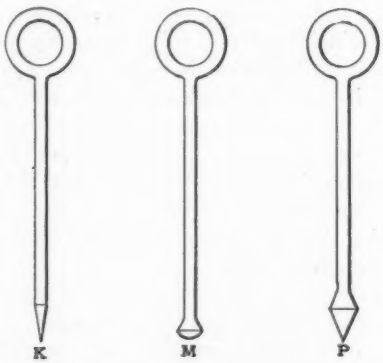

FIG. 5. DIFFERENT FORMS OF VENT WIRES.

pressed into rammed sand. A trial of both K and M will surprise the novice with how much less force is required to press M than K. Some, to obtain advantage of the point feature, combine the two to have vent wires appear as at P, but the point does not attain the

ease that one would think it should. However in the case of wires over ¼ in. diameter, P is a good plan to adopt.

Advantages and Evils of Open and Closed Risers.

In treating the question of open and closed risers, we take up a subject that molders do not agree upon, the difference being that one or two writers hold that all risers should be kept open, while others maintain that depends upon such conditions, the writer taking sides with the latter.

The action of risers, whether closed or open, is in the former case an action which maintains a pressure of air and gases between the surfaces of the raising metal and cope, while in the latter case there is little or no pressure, accompanied with the friction of air and gases rushing through the mould to escape out of the risers. The benefits derived from affording free escape for the air and gases through venting and open risers lie in removing the chances of gas cushions which might prevent the metal filling all corners, edges and plate parts of moulds and in often causing blow holes, etc. The benefits derived in keeping all risers air tight lie in maintaining an air pressure in moulds that will aid sustain suspended bodies and prevent the escaping air and gases to disturb pieces of the mold, carry blacking dust and dirt to be lodged under projections, etc., or to be carried out of the mould, and is in a manner to be compared to what would occur if one could open and close the mouth of a volcano or in a milder way the difference in the commotion of air that prevails in and out of doors during a wind storm.

The commotion of air and gases in light work moulds, aside from carrying dusts, can do little harm for the reason there is little body of metal and moulds are quickly poured, whereas in heavy work we have the reverse conditions. The statement has been published in the *Foundry* that all green sand moulds could be cast with open risers. I am afraid that the writer making that assertion has had a limited experience. I think I could give him green sand jobs that he could not obtain perfect castings by having open risers. I believe that another writer claimed that the face of heavy plate work was not rammed hard enough. It is true that hard ramming and good close venting may make it possible to cast certain lines of heavy plate work with open risers, never-the-less I fail to perceive wherein any thing is gained in casting such work with open risers, and if there is nohing to be gained, wherein lies the advisability of taking chances of evil occuring, and which chiefly lies in the dan-

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ger of "drawing down" with plain plate surfaces and disturbing delicate bodies of sand in complicated designs to start a mould to blow, which when once begun often permits the metal to come in contact with rusty nails and rods and fill vent passages for the escape of gases with metal, often causing a mould to resemble a live volcano.

DRYING MOLDS.

The Foundry, November has a timely article by Henry Hess in which he draws a comparison between the crude methods we have over here of drying molds with coke or charcoal stoves, and the well designed systems of blowing hot air into the finished mold in use in Europe. He goes into several methods, and gives as his opinion that the best system is a small motor-fan outfit blowing air through a coil of pipe kept hot in a suitable stove full of live coke. This gives a good supply of clean hot air for drying purposes and is very flexible in its application. Such a system is to be recommended, and it is hoped that our American foundrymen will look into it more.

FOUNDRY PATENTS.

Edited by S. H. STUPAKOFF, 545 Turret St., Pittsburg, Pa.

Questions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Stupakoff

RECENT PATENTS OF INTEREST TO FOUNDRYMEN.

No. 748,771. *Electrically Driven Centrifugal Machine.* Patent granted January 5, to Henry G. Morris, Philadelphia, Pa. The armature of the motor is mounted upon the upper end of the rotating parts, and the fields form a part of the stationary portion of the machine. This gives it in general the appearance of the turbine driven generators, such as are used at the power plants of Niagara Falls. The proposed arrangement simplifies the construction of electrically driven centrifugal machines, and should be convenient for foundry mixers. To judge from the patent drawings, it may be necessary to make some considerable improvements in the design of the details, in order to make it more accessible for adjustment, cleaning, etc. The patent covers distinctly a centrifugal machine driven directly by alternating current motor, and yet, no good reason could be given why the same arrangement would not work equally as well with direct current machines.

No. 747,289. *Hand Operated Draw Plate and Stripping Plate Combined.* Patents granted December 15, 1903, to Wm. G. Wood, Chicago, Ills. Claims are based upon the reversibility of a hand operated device, which is old and well known when used in connection with Molding Machines. If the stripping plate and draw or pattern plate with its guides are removed from any old molding machine we have the identical apparatus which Mr. Wood claims as his invention. It would be a wonder if he was the only one to whom it ever happened that his machine broke down, and who upon exercising his ingenuity found that with a little makeshift arrangement, the stripping and draw plate could be used in many cases without being attached to and operated by the machine.

No. 748,896. *Flexible Mold.* Patent granted January 5, 1904 to Jesse F. Spencer, Philadelphia, Pa. Claims cover a mold of vulcanized rubber or similar flexible substances, with an exterior surface following the general contour of the pattern and an interior

surface which may be undercut in a manner which would not permit the molding of the article in an ordinary mold. This device is undoubtedly intended for casting substances like plaster paris, chocolate, rubber, cement, etc.; but it is not impossible to make use of it in exceptional instances in the foundry for the making of difficult oil sand cores. If suitable materials are selected they may, perhaps, be baked in such a mold without damaging either.

No. 749,103. *Brake Shoe with Steel Back.* Patent granted January 5, 1904, to F. W. Sargent, of Mohwaw, N. J; The claims cover substantially a brake shoe with a steel back, with edges imbedded in the casting.

No. 750,653. *Abrasive Wheel Center.* Patent granted January 26, 1904, to David B. Hyde, Springfield, O. Comprises a three part fixture for securely fastening and conveniently interchanging ring shaped abrasive wheels. The device is well designed and it should be a welcome money-saving innovation for the grinding room. It can be adapted to the spindels of existing wheel stands.

No. 749,258. *Process for purifying and refining melted iron in the cupola by injecting steam.* Patent granted January 12, to Herbert C. Cochran, Kansas City, Mo. The iron is heated as usual by an air blast to a high temperature, and when in a molten condition, "steam is injected in an angular downward direction, about 10 inches below the melting point of iron, through the mass of melted contents and incandescent fuel" (as stated in the claims). Patentee claims to produce by this process a cast iron possessing some of the qualities of malleable iron. He evidently means the "melting zone" of the cupola when he speaks of the "melting point of iron."

We have no representative of the insurance fraternity among our members, otherwise we might be regaled by a prolonged howl when these presents reach him. We see in our mind's eye the smoke from the cancelled insurance policy float upward and mingle with that of the foundry trying this rash experiment. Suppose the steam were wet, and the little drops of water should come in contact with the festive globule of melted iron.—We pause, shed a tear—and turn to the next subject.

No. 750,641. *Vibrator for Molding Machine.* Patent granted January 26, to Frederick W. Hall, Camden, N. J. The novelty consists in a controlling valve projecting in both directions of its

movement through the valve body and engaging in these places with pipe connections between the valve body and the cylinder. The pipes are provided with exhaust ports. Moral: "How to get around another fellow's patent."

No. 750,559. *Molder's Flask and Gated Pattern.* Patent granted January 26, 1904, to Henry G. Voigt, New Britain, Conn. The inventor uses his ingenuity to devise a novelty for lifting and guiding gated patterns by means of special lifting plates and special flasks. He makes the bearing portions of the patterns rest on the sides of the flask and has them protruding outwardly. The cope is provided with lifting pins, which are operated by a suitable lifting mechanism. But for the edification of our readers we will let the patent attorney say the rest by quoting verbatim the 10th of his 11 claims:

"10. A cope-section; a drag-section; and a pattern comprising bearing portions extending beyond the sides of the assembled flask-sections, combined with a longitudinally-slotted guide-pin at each side of the flask and extending from the drag-section; a guide-block located on the inside of each guide-pin and adjustable both longitudinally and transversely of the pin; screws extending from each guide-block and constituting positioning devices for determining the lateral adjustment position of the block; a fastening-screw extending through the slot in each guide-pin and engaging with the block on the inside of the latter; brackets at opposite sides of the cope-section and a co-operative guide device adjustably secured to each bracket and engaging with the outer face of the guide-pin at that side, said projecting bearing portions of the pattern, each having at the side of the flask a notch the walls of which engage with the inner face of said guide-block on that side."

No. 747,396. *Sand Blast Apparatus.* Patent granted December 22, 1903 to Neal Farnhan, Chicago, Ills. The inventor introduces an ejector nozzle, which he places within a branch of the air pressure pipe, directly behind the vertical terminus of the sand discharge pipe, leading from the sand tank. Both pipes are connected by a speciail inclined fitting. This undoubtly makes the sand blast more effective, and may be useful for foundries using this process for cleaning castings. Experiments or actual service will have to prove if the erosive action of the sand will not unduly hasten

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the destruction of the blast pipe in front of the ejector nozzle.

No. 736,131. *Melting Furnace.* Patent ganted August 11, 1903 to R. Moldenke. For the description of the process this patent is intended to cover the reader is refered to the article on "Uniformity in Malleable Heat" in another part of this Journal issue.

BOOK REVIEW.

MANUAL OF QUALITATIVE AND QUANTITATIVE ANALYSIS, by Prof. A. Ledebur.

The sixth edition of this well known manual for the iron laboratory has just been published(in the German language). After taking up the qualitative testing of ores, the methods for obtaining the exact amounts are given. We note among the regular methods for determining the ordinary elements met with in iron and steel, also some on the estimation of titanium, chromium and vanadium. For pig irons and wrought irons we also see tin, aluminum and oxygen cared for, as well as nickle, cobalt and antimony. These are things which will be looked into closer in our country in the future. The determination of oxygen is certainly the most interesting, in view of its intimate relation to the ultimate strength of the material in which it is present. Prof. Ledebur holds that not only is oxygen present in iron subjected to oxydising influences during melting, from the solution of the iron oxide formed, but also from the dissolved oxides of manganese, chromium and other metals. He determines the oxygen by igniting 15 grammes of the borings, free from all oil, in a current of pure hydrogen, and weighing the resultant vapor of water. While this method does not catch all the oxygen, some oxides not being reduced this way, yet there is nothing better known in this line at the present time. The volume has 140 pages, and 24 illustrations. It is published by F, Vieweg & Son, Braunschweig, Germany.

NOTED MEN IN THE FOUNDRY WORLD.

PROF. DR. A. LEDEBUR.

American students of metallurgy will always remember the investigations of this famous metallurgist, who honored us last year by accepting honorary membership in our body. The results and conclusions which he published years ago, as we were just getting an inkling of what might be ahead of us in our chosen profession, are today as sound as ever. Especially in the field of the malleable casting, and the science of annealing, has Prof. Ledebur done much to explain the peculiar condition of the carbons met with. He discovered the so-called "temper" carbon, and named it thus. While this is a little strange to our ears, the term "tempern" meaning annealing, yet the right of the discoverer has ever been held sacred, and so the term will stick.

Prof. Ledebur was born in 1837, in Blankenburg, in the Harz Mountains. After receiving the education usual to the day, he entered the foundry of the Harz Iron Works, and thus shaped his after career. Later on he took a course in technical study, and in 1862 took charge of the Ilsenburg Iron Works. From here he went to Berlin to manage a large foundry and iron works there, leaving in 1871 to accept a similar post in Saxony. It must be remembered that in Germany most of the large foundries are at the same time connected with blast furnaces and finishing shops, so that Prof. Ledebur not only became an authority on founding, but also on the blast furnace.

His taste for investigation, and the memoirs and works he published brought him a call to the chair of Metallurgy in the world famed Royal Mining School of Freiberg, and he has been ever since actively engaged in instruction and investigation there.

Many articles have appeared from the pen of Prof. Ledebur, but he is best known by his substantial work on the properties of pig iron and its uses in the foundry. We are perhaps more closely interested in his handbook for the iron and steel foundry, of which the fifth edition appeared in 1901. Perhaps the best reason for Prof. Ledebur's prominence in his chosen field lies in the fact that up to his 39th year, he was actively engaged in doing the things he

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subsequently wrote about, and even since leaving active service, he has kept in touch with the men who make history in iron and steel circles.

May we see his active mind impressed on many pages of the annals of our industry yet to appear.

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Managing Editor DR. RICHARD MOLDENKE, P. O. Box 432, New York City.

ASSOCIATE EDITORS:

THOMAS D. WEST, Sharpsville, Penna.
HERBERT E. FIELD, P. O. Box 432, New York City
S. H. STUPAKOFF, 545 Turret St., Pittsburg, Pa.
JAS. A. MURPHY, P. O. Box 432, New York City.
WM. H. PARRY, 664 E. 31st St., Brooklyn N. Y.
KENNETH FALCONER, 34 Staynor Av., Westmount. Montreal, P.Q.

EDITORIAL COMMENT.

INDIANAPOLIS CONVENTION OF THE A. F. A.

By the time this issue reaches our members, active preparations will be under way by, we hope, very many of them to journey to Indiana's beautiful capitol city. While generous entertainment will be given us there, special stress is to be laid on the business features of the gathering, as matters of unusural interest are to be presented to our foundrymen at that time.

We also hope to see our ladies out in full force as their presence has always added tone to the occasion, and the proximity to St. Louis will this time make the journey all the more interesting.

It is the hope of the Executive Board that new sections for former patternmakers and foundry accountants may be created, so that the good work of our body is extended. The programme will be arranged to take up these matters, and papers and discussions now promised indicate most interesting sessions.

Our members and their foundry friends are heartily invited to attend and take part in the proceedings of the Association at Indianapolis, June 7, 8 and 9.

SELLING PIG IRON BY WARRANTS.

By the time this reaches our readers there will have been settled what may be called the largest contract for castings ever let.

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We allude to the segmental plates for the Hudson River tunnel of the Pennsylvania Railroad. One or more of the fifty foundrymen who were bidding on this or figuring to do so will have received the plum and the others will pursue the even tenor of their ways and be sorry they missed it. The bug-bear in this job is the insurance of the price of iron for the next three years. Had the English Warrant system been in force here, with the necessary American modifications, there would have been no trouble and little risk in this rather large undertaking.

Mr. Geo. H. Hull has been for years urging upon the iron interests of the country the desirability of utilizing the lean years for the production and storage of pig irons, so that "when steel is prince" there might be no undue soaring of the price of pig iron, with the consequent depression to follow when people make up their minds to wait.

The idea is gradually gaining ground that more stability is a necessity in the pig-iron market for the protection of everybody affected. Mr. Hull is to give us a discourse on the subject at the coming convention, and our member Mr. Howard Hooker, of Pittsburg is actively pushing the selling pig iron warrants on the Produce Exchange of that city, the warrants to stand for the actual iron made and stored. With our pig iron specifications, the brand name, and the chemica-composition of the unit represented by the warrant on its face, the transaction becomes at once so certain and so easy to consummate, that the small cost involved proves an excellent insurance for the foundryman who has long time contracts on hand and wishes to secure himself to the utmost.

It has often been said that Insurance is but in its infancy. Here then is another line in which it can become very valuable to us.

* * *

THE PATTERNMAKER.

The new candidate for favors in the foundry field is *The Patternmaker*, and it is assuredly destined to fill a long felt want. We hope sincerely that those most interested will see that this new journal waxes strong and expands. The mere fact that a journal devoted to this special branch of the foundry industry is called into being is a sure indication that the field is over-ripe, for such an enterprise is expensive and is not entered into unless the chances for success have been carefully weighed.

At our last convention there was a strong tendency manifested toward the establishment of a section for our pattern foremen, just as we have the foundry foremen and the metallurgists represented. While we hope that this desirable object may be accomplished at Indianapolis, yet we feel that the question is even broader, and there is a great need for a general association of patternmakers, founded on educational lines, which will bring together the men pre-eminent in that craft.

We invite all patternmakers to attend our convention and see if they cannot get together, becoming a body for themselves, and at the same time forming a section of our association in affiliation. Thus will a harmonious blending result, and the various branches of the foundry industry meet together in council, to the lasting good of all, and a distinct gain to the country.

We further commend *The Patternmaker* to our members as worthy of their best support, and incidentally suggest that they send their pattern foremen to the convention where they will become acquainted with the editor of that Journal, and each other, thus deriving the benefit of personal interchange of ideas.

THE AMERICAN SOCIETY FOR TESTING MATERIALS

The proceedings of the sixth annual meeting of this Association, of which we also are members, lie before us in the shape of a substantially bound volume of almost 500 pages, of which 58 are devoted to cast iron.

Prof. Edgar Marburg, a well known engineer, is the secretary, and to his executive ability and energetic procedure the present standing and success of this society may be attributed.

Perhaps no association of the active and pre-eminent men of the country's industries is of such value to the nation. While others strive to improve their membership in special lines, here we have the maker, the user, and the engineer of tests combined as a sort of clearing house for the industries of the nation, so far as their product is concerned. No wonder that the specifications advanced for steel, iron, cement, and other materials; based upon the actual working conditions of the country, are rapidly being adopted on account of the security given to the buyer, and the fairness to the maker.

So far as we are concerned, the specifications, for pig iron,

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and those for cast iron and finished castings are of greatest interest, being in fact gotten up by our members on the general committee for the purpose of the above-named association. The liberality of these specifications to the foundryman is coupled with a similar one to the furnaceman, while all the time strictly just to the consumer. Hence we should study these specifications, on which we will be called upon to make much work hereafter, and help make them effective.

From the other side of the water come many expressions of interest, especially along the line of pig iron specifications, together with the pious wish that they may be extended to cover Europe also. The high sulphur and irregular silicon foundry iron-making furnaces evidently need to be squeezed into narrower and better limits for the greater happiness of the foundrymen affected. We urge our large foundries to join this association as immeasurable good will come of its work.

THE AMERCAN INSTITUTE OF MINING ENGINEERS.

It never rains but it pours. Our Association has evidently centered everyone's attention on cast iron. Discussions on the metallurgy of this material are multiplying rapidly and forming the subject matter of special sessions in the proceedings of our great engineering bodies. The Atlantic City meeting of the American Institute of Mining Engineers, as reported in a special number of the *Iron and Steel Metallurgist,* teemed with material relating to foundry practice. The specifications recently advanced for pig iron and for testing cast iron and finished castings came in for a full and fair discussion, and met with general approval.

The American Institute of Mining Engineers was probably the first association to take up the study of cast iron from the metallurgical side, and has done much good work in that direction. Comparing the papers of the recent meeting with those of the early times in which little other than hopes and desires are expressed, the advance has been most marked.

We hope that the several associations will continue this work of education. They cannot do too much of it to please us, and in joining with us in disentangling the twisted strands of knowl-

edge concerning cast iron, we will all arrive much sooner at definite lines of safe procedure in foundry metallurgy.

* * *

FOREMEN IN FOUNDRIES AS EDUCATIONAL FACTORS.

Five years ago who would have thought that the intensely practical foundry foreman could be guilty of discussing the effects of sulphur, manganese, and silicon on his work, and carefully following the chemistry of his melting process. Yet to-day this is actually the case, and he is outdistancing his employer in his eagerness to learn all that he can of the principles underlying his daily work.

The above is written from actual observaton both in foundries and while attending the various meetings of the Affiliated Foundry Foremen, which organization is built up on educational lines only, and forms the foremen's section of our Association. The contempt for science in the foundry of ten years ago has been completely dissipated, and that so rapidly that our progressive shops are now run by men who have no difficulty in averaging up their silicon in the daily mixture, or varying the component parts at will with perfect knowledge of the resulting effects.

There can be but one result, and that is the improvement of the individual. Could we induce the better class of molders to get together for self-improvement only, how much good would be done. If the unions, instead of discussing only their grievances would lay special stress on the acquired skill and proficiency of their members, we would hear little of the minimum wage and limitation of output. Our Association welcomes the molder just as much as the owner and the foreman or metallurgist. Let us all get together on the higher plane of intellectual advancement, and things will unroll themselves smoothly and easily. Then will our former President's prediction concerning the labor leader of the future be realized, and him we do not fear, but welcome. Let the employer encourage any movement among his employees based on education, for if he is pushed for higher

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wages as a consequence of better and more intelligent work, he would be standing in his own light to kick.

EXPANDING CAST IRON BY HEAT TREATMENT

Among the valuable discoveries recently brought out in the field of cast iron is one by Mr. Outerbridge. The fact that iron can be expanded permanently by heating has long been known both by the maker of malleable castings, and the blast furnace man, who formerly used cast iron stoves for heating the blast to his occasional sorrow. The matter has, however, received systematic attention by Mr. Outerbridge, and was carried out to a length which makes the results available in many cases where money can be saved a foundryman.

The technical press has been full of the descriptions of the "growing" of iron castings, and hence this need not be commented upon here. However, the application in the shop, where a diameter of a turned casting can be increased slightly by repeated heating to redness, and thus many repair parts be, so to say, rejuvenated, has not been dwelt upon as much as should have been the case.

Then again another point must not be overlooked. Wherever a gray casting, which is the one peculiarly affected by repeated heating to redness and cooling is to be subjected to such influences in a structure, be it a grate or piece of apparatus, the designer should keep Mr. Outerbridge's discoveries in mind when laying out the work, so that due provision be made for the easy movement or replacement of the heated portions without disarranging the installation.

Thus one more line of results has been given to the foundry which show the peculiar behavior of cast iron under influences which are of everyday occurrence. By and by we will reach a point when we can say that we know something of the material we turn out in so big a tonnage annually.

PIG IRON SPECIFICATIONS FOR MALLEABLE CASTING PURPOSES

Whatever is done in any malleable casting shop of the world is always of interest to our American Malleable men, for no

branch of the foundry has competition for work any stronger to contend with than this. From Germany comes information that over there the lack of low sulphur irons is the chief difficulty met with, crucible work running between 0.07 and 0.12, in sulphur, with exceptional cases of 0.20. Cupola castings never contain less than 0.14, while the usual range is between 0.18 and 0.25. Once in a while 0.30 is reached. No wonder that their product has a different structure than ours. Dr. Wuest, of Aachen, a member of our Association, who comments upon the conditions existing in Europe gives a set of tables showing the composition of the pig irons sold for malleable purposes there. From this we see that their silicon, total carbon, and manganese range is just like ours. The phosphorus has a much lower minimum limit, being down to .038, though the upper limit of .155 fits our case very well. Their sulphur, however, with 0.008, or very high grade material for a minimum, runs up to 0.553 as a maximum. The latter figure seems incredible to our view of the matter, but bears out what we have seen in English castings. In fact the high sulphur iron quoted above is of English make. The fluctuations are also remarkable, and that the foundry industry puts up with them is a sign of inexperience with this side of the problem.

Furthermore it would seem that Germany has had the same trouble with English irons exported to them that we had last year, and the sooner it produces its own pig irons for foundry purposes, or buys ours, the better. No iron with 0.553 sulphur, whether English or not, would find its way into castings here. We doubt if we would ever care to use it for sash weights. If it has been sent to Germany, it was doubtless to someone who judges iron by fracture, and therefore cannot tell one white iron from another.

Would it not be a good thing for Germany to adopt some such specifications for pig iron as we have, and extend them to cover the malleable shop?

* * *

BABY-BESSEMER PROCESSES.

A veritable fever for establishing Baby-Bessemer plants seems to be raging in Europe at the present time. It is as if a microbe had bitten many gray iron and malleable founders, and

caused them to add these plants to their establishments and thus enter into fierce competition with existing steel foundries.

The results are natural. Failure everywhere. The idea of Bessemerizing iron to make steel was only perfected by its illustrious author by the application of science and consummate skill. Others had failed to get his results while trying his methods. They missed the little points. So here also. The Baby-Bessemer process in itself is all right, but must be carried out with even more skill than is required for its big brother, otherwise commercial failure is certain to result.

On the whole we advise foundrymen who contemplate the addition of steel casting plants to stick to the Open-Hearth process, unless they are sure of obtaining the best of experts for the other. With the steel casting industry in this country as demoralized as it is at present, any venture in that direction is a pretty risky business for the foundryman who has not sufficient surplus to carry this load for a few years. And where are the foundrymen to-day who have a big surplus?

CAST IRON

Perhaps the most notable thing in the line of cast iron that has taken place recently was the publication of the report of the Committee on testing Cast Iron and finished Castings. This committee of over sixty-five of the best known experts in furnace, foundry, and shop, with Mr. Walter Wood for chairman and Dr. R. Moldenke for secretary, got together and through sub-committees went carefully into the several subjects assigned them, getting out the first American specifications which place the purchase of casting as well as pig iron under definite guarantees for quality.

The several subjects provided for are as follows: Foundry Pig Iron, Pipe, Car Wheels, Cylinders, Malleable Castings, and Gray Iron Castings. The last named item being in fact cast iron in general. The specifications for pig iron and for cast iron will be discussed at the coming convention.

On all this work the American Foundrymen's Association was fully represented. In fact the tests made for us served as a basis for the deductions made. While these specifications are

not yet finally adopted, they are certain to be as the men who got them up are the foremost of the country along these lines.

At the recent meeting of the American Institute of Mining Engineers, these specifications were discussed. Each committee chairman presented his specification, and gave the reasons for their selection. A lively discussion followed, and much of interest was brought out. Pig iron for the foundry was gone into at length, and the reasons for specifying only the silicon and sulphur were stated. The discussion further brought out why phosphorus and manganese are omitted in the specifications, though looked after carefully in the selection of the brand.

The physics of cast iron were also taken up, in the way of a general review of our advance in knowledge in this direction together with what we still have to learn.

Mr. Henry Souther went very fully into the need of standard specifications for testing cast iron and iron castings, giving a series of results with the new arbitration bar recommended by the committee, and showing its adaptability for general work with the safety from external troubles it offers. Mr. Robert Job gave the specifications in use by his railroad, which while quite good show the necessity for cutting away from individual specifications and uniting on more general, liberal, and just as effective ones.

Dr. R. Moldenke gave a paper before the New England Foundrymen's Association which also went very fully into the testing of cast iron and developed the reasoning upon which the adoption of the standard specifications above referred to were based. In Europe Mr. Oskar Leyde discusses this problem and finds as we do that the attaching of coupons is poor policy, as the results are altogether unreliable. He made a series of tests which show what we have long known, but nevertheless it is good missionary work right where very much needed. The same can be said for an article on Coke appearing in *Stahl und Eisen* where the question of moisture that is paid for as coke is touched upon pretty thoroughly. Here we expect to have something at the coming convention also, for foundry coke is a burning subject, especially when prices are up and sulphur too.

Mr. Herbert E. Field goes into the defects on cast iron, their causes and remedies. This paper, read before the New

England Foundrymen's Association, is a very thorough one. Shrinkage comes first. We can never get over this disagreeable feature, but it may be reduced to be harmless. The design of the casting has much to do with this, the thickness of the metal if kept fairly uniform will stop much of this trouble. Then the pattern should be so made that shrinkage which we know will be there anyhow can be cared for. Casting at the right temperature, with proper feeding, risers, etc., all these things belong to the art of founding and should be known and applied. The composition of the iron should be carefully watched so that herein no errors are made. The mixture must be properly proportioned for pig and scrap. A series of valuable hints are given on how to prevent undue shrinkage, which make good reading for the foundryman. Blow holes, cracks, cold-shuts, and general weakness; dirt, and hardness, are taken up severally and thoroughly ventilated.

ALLOYS

In the *Foundry* for April, Mr. H. E. Field comments on the unreliability of laboratory experiments in the way of making very high tensile strength alloys. Thus, for instance, Prof. Thurston's well known metal with copper 55, zinc, 42.05, and tin .05, which should give 68,000 lbs. per sq. in., may do so in the laboratory, but cannot be made as good as that commercially. To get the best shop results it is necessary that three things be observed: First, to use pure metals; second, not to overheat; and third, to add aluminum, if necessary.

Manganese Bronzes are discussed in the *Giesserei-Zeitung*, of March 15. It is the custom to add phosphorus to melted copper to care for the oxides constantly forming. Now this means some of it remaining behind, and consequent trouble in rolling. Manganese is a better material as whatever is left behind is a benefit rather than otherwise. The best alloy is a 30 per cent. manganese and copper alloy. Manganese bronze castings with 5 per cent. Mn are much used in Germany, the English increase their manganese to 12 per cent. in castings. Where the alloy of manganese and copper is used for ordinary zinc, good strengths are obtained, and 2 per cent. manganese usually remains behind.

FOUNDRY MANAGEMENT

Among the recent articles relating to foundry management may be mentioned one by Mr. Thos. D. West on Fan Power for the cupola. He goes very fully into this, describing the difficulties the foundryman gets into when providing too small an engine or motor for his fan. He speaks from his own experience, having put in a 75 HP motor to run a fan rated at about 45 HP. Tests made afterwards developed the fact that to run this fan under load required 92 HP and running free 115 HP. Mr. West suggests that experiments be made to place this matter on safer lines for the benefit of foundrymen, and more of this will be heard at the coming convention.

"Limestone in the Cupola" is the title of a paper by Mr. N. W. Shed, published in the April *Foundry*. He recommends about 40 lbs. of limestone to each ton of iron used, or 15 per cent. of the weight of the coke charged. The limestone should be broken up into one inch blocks and scattered over the coke. The amount given above is the average for regular melting. Where a heat is to be run out unusually quick and hot, the amount may be increased to 20 per cent. of the coke charged, but such large amounts require careful attention as the slag will get very refractory. There is little danger of cutting out the lining more heavily by an additional amount of limestone. The only thing to look after is that the limestone is reasonably pure. The less silica present the more active the limestone can be for slagging off the sand of the iron and ash of the coke. Limestone reduces sulphur to some extent, protects the iron from undue oxidation by furnishing a slag cover, and makes a clean cupola.

Permanent molds forms the topic of a short article in *Stahl und Eisen* for March 15. The Germans have done much along this line, perhaps more than we, and it were well if we looked into this question more carefully at many of our foundries. The article goes into the making of annealing pots for wire mills. Lots of fifteen are turned out from one mold with but little patching up each time. A brick mold is built up between suitable base and top plates, and the mold is swept up properly with loam. The core is also swept up with loam, and is made of a perforated steel shell shrunk on a casting which drops into the top plate of the mold. Iron U pieces are pushed through the loam and the plate perforations to be wired together within, so that the body of the loam is

well anchored, and trunnions allow the core to be tilted and dropped into the mold. Pouring is done through a series of gates provided in the top plate of the mold, and no difficulty is experienced in getting out fifteen good castings before sweeping up again anew.

In the *Engineering Magazine* of March, Dr. R. Moldenke contributes an article on Labor-saving Machinery in the Foundry. He takes the reader through a modern foundry and discusses the various types of labor-saving devices which have taken away the hard work of the men wherever they are installed. In spite of the active hostility of the men, and the inertia of the foundryman himself, labor-saving devices are gaining ground everywhere, and we need only enumerate such things as molding machines, power cranes, industrial railways, conveyors, hoists, sand handling machines, pneumatic machinery, tumbling barrels, etc., to prove this. Yet there is much to be done, and while there is room for continued improvement in the mechanism gotten up, those already available should find entry into more shops than they do, so that greater economy may be realized, and the trade of the country prosper.

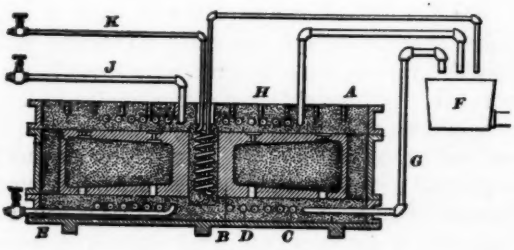
An article that is going the rounds of the German press first appeared in *Stahl und Eisen* March 15th. In the method described the castings are piled upon a lead covered bench, and acid-water sprayed on them from above and from the sides. The surplus acid-water running off collects in a sump let into the ground, and is sent up again by a centrifugal pump. The castings are thus in the air all the time, and are kept moist continually. After the sand has become loosened, so that washing will remove it completely, they are allowed to lie in the air for a few days and then cleaned and again allowed to lie, to rust. The method with modifications has been in use in this country one might say from time immemorial, only that we throw a few buckets of acid-water on the castings and allow the action to take place during the night, the night watchmen seeing that the castings are kept wet all the time. This is done in all the old malleable shops, though we prefer the tumbling barrel as more expeditious and cheaper, where the castings are not liable to be broken.

* * *

METHOD OF ARTIFICIALLY COOLING COMPLICATED CASTINGS.

In our January number we gave a description of Mr. Wm. A. Bole's method of getting satisfactory results in making castings where the cooling and shrinkage strains are excessive. We rather doubted the general applicability of the method, and advised foundrymen to go slow about it.

It is with great pleasure, therefore, that we give some further explanation on the subject just received from Mr. Bole, for we are all searching after truth, and whenever any comments of ours may not put a new method or device in the light it is really entitled to, we welcome further instruction regarding the proper way to get out the results wanted. Mr. Bole's letter speaks for itself, and we append the original illustration, so that our readers can follow the argument more closely.



"I think that the average reader would construe from your comments that this is a fanciful and not a practical matter, and I would like to advise you that this invention was born of a dire necessity. It was used by us in a very large number of cases, not for the purpose of cooling down a piston casting, as shown in the illustration, but for the purpose of so treating a very much more complicated casting, namely, large cylinder heads for Corliss engines, having the ports for steam and exhaust passages cast in the heads.

In the making of such castings there has been experienced the greatest kind of difficulty in preventing the bars or ribs from cracking, which bars span the port openings on the cylinder side of the casting. Other well known concerns have had such poor

success in making these heads that they have been driven finally to leave out the cross bars entirely, which makes a weak and less trustworthy head. Where the metal can be put in as the designer wishes it, and can also be kept in such a state of repose that it acts as contemplated in the design, a much better job is the result.

Several castings were lost by us before we discovered how to save them. The defect is a purely physical one, and cannot be remedied by changing the mixture of Irons melted for this purpose. In fact I know of more than one large power house equipped by our competitors, in which a tremendous amount of trouble was experienced from this defect. On the other hand, since we have employed this method, not a cylinder head casting has been lost from this cause, and we have made something like fifty of these castings, using this method of controlling the cooling. In a large station in New York, where we have installed eleven large engines of about 6,500 HP each, each of which engines has four such Corliss cylinder heads, all treated during the cooling by this method, not a single one of these heads has a cracked port bar. Is this a sufficient demonstration of the "practical" nature of such a method?

I used the piston as a simple illustration, because it was not as complicated a casting as the cylinder head, and more readily illustrated the intent. I think, however, that if you will submit this sketch of a piston to any engineer, not necessarily a foundryman, he will tell you that the design is scientifically accurate, the thick and the thin portions of metal as used representing the proper capacity to resist the strains imposed upon each respective point.

It is true that in the hands of the careless and incompetent workmen such method of introducing water into the mold at a point close to the molten metal might bring about an accident. If, however, the end shall justify the means as fully and completely as in the cases of practical application which I have above cited, then it is worth while to be sufficiently painstaking and careful so that our own exemption from accident in the foundry might be the experience of other foundrymen who tried to use this process. We have never had the slightest trouble with some fifty of these molds, except once where the pipe fitter was

negligent about screwing up the joints, and where some water was therefore enabled to leak out of the pipe into the sand core. The consequence in this instance was simply a cracked casting, because the water produced almost instantaneous cooling at this particular spot, thereby defeating the purpose of synchronous cooling throughout the casting. There was no explosion nor any other demonstration of danger.

I think that a great many of the mysterious breaks with which all experienced engineers become familiar may be traced back to the foundry, to the time when the castings were cooling. Every practiced foundryman has resorted to the expedient of baring and exposing certain portions of castings in order that such portion may be cooled in advance of the time when it would naturally cool if left alone. In some cases it is a fly-wheel hub that is so treated, in other cases, perhaps a fly-wheel rim which needs this assistance. But, many castings have their critical spots so located as to be inaccessible to such simple treatment, and the cylinder heads to which I have referred could not be saved by any such stripping process. I believe that very many critical castings of large sizes may be apparently quite sound and free from defect, while really they are so disturbed by " internal dissensions," that is, by internal molecular stresses, as to be just ready to rupture at the first sign of additional stress put upon them in service. Of course this is much more likely in large and complicated castings than in small ones, and may have much to do with the feeling quite prevalent in some quarters that iron castings are uncertain and unreliable."

On the whole while we regret exceedingly that this interesting method was treated rather too lightly by us in the last issue of our journal, yet we rather feel that our members are to be congratulated upon having been given the above most interesting details as a consequence. The method while patented is not on the market, and especially not to competitors, (as can be easily read through the lines above). Hence Mr. Bole's earnest desire to put on record valuable phenomena in connection with the casting of iron is to be doubly commended.

XUM

PATTERN MAKING

Edited by WM. H. PARRY, 664 East 31st Street, Brooklyn, N. Y.

Questions, comment and criticism are invited. Kindly direct all correspondence along the lines of this department to Mr. Parry.

THE INDIANAPOLIS CONVENTION

As this convention is announced for June 7, 8, and 9th, in that city, we feel it our duty to invite all pattern shop foremen imbued with the necessary progressive spirit to attend the different sessions, and especially the one to be devoted to the reading of papers and discussions on subjects bearing directly on the management, equipment, and maintenance of the pattern shop.

Every pattern shop foreman desiring to read a paper before the convention on any subject pertinent and revalent to the trade will be welcomed most heartily, and given the opportunity to interchange his ideas with those of the others to the fullest extent. The end sought is the formation of a permanent organization of pattern shop foremen, which in the light of the present tendency of all department heads to organize, should be a simple matter, bearing in mind, of course, that the sole reason for organizing is first and last and all the time—EDUCATION.

Kindly address the editor as to your intention to be present, either as listener, or better still as one who will contribute to the papers and discussions. In this way everybody will be given the opportunity to help the good work along.

THE PATTERNMAKER

The first issue of *The Patternmaker* made its appearance March 1st, and verily it "came in like a lion," as everyone interested in the gentle art of making patterns will be convinced who peruses its pages.

The number opens up with a description of the pattern storage and shop buildings of the Allis-Chalmers works at West Allis, Wis. A well written and profusely illustrated article. Then follows an article from the pen of Mr. R. W. McDowell, who

delves deeply into the subject of pattern records. Prof. M. J. Golden, of Purdue, writes about wood for patterns, and does this so thoroughly that his deductions can stand as established facts. Mr. J. L. Gard contributes an article on System in making large Patterns, and as every line that Mr. Gard writes is full of meat, no comment is necessary.

Propellor wheel patterns is the subject chosen by Mr. H. J. McCoslin, of the Wellman-Seaver-Morgan pattern shops at Cleveland, and while we disagree with him entirely on the method to use in building a twelve-foot propeller yet it discloses one way in which this work is built in one shop, and further comment would be cruel.

The anatomy of a large pattern, by the ever enterprising Mr. Gobeille, of Cleveland, is postively first-class in every particular, and considering Mr. Gobeille's well known antipathy to disclosing his methods and the "innards" of his plant, we hope that he will continue to mellow with age sufficiently to enlighten us further on how to make *cheap* patterns *cheaply*.

Prof. Hoffman, of Purdue, writes about the patternmaker and machine designer, and it makes one feel that the day is not so remote as it was, when the machine designer really does know enough about pattern-making and molding to make his work practical.

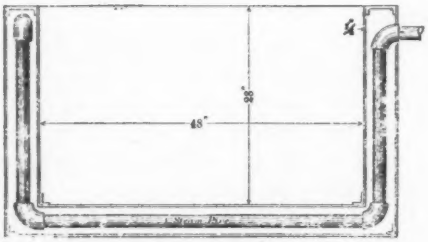
The editor pleads guilty to the next contribution, the subject being "lags," showing a method by which lags or staves can be sawed concave by fixing the fence on the saw-table to the desired angle. It is no more than fair, however, to state that Mr. W. Newton, of Oneonta, N. Y., wrote entertainingly on the same subject in the *American Machinist* of Feb. 4th, page 161.

THE FOUNDRY.

In the issue for January Mr. P. M. Ramp, of the Chicago Wheel and Foundry Co.'s plant contributes an article on stripping plates, wherein he advocates them to be made of wood. This avoids the expense incident to metal plates when but few castings are to be made.

For the preparation of the lumber for this purpose a special tank is required, and it strikes us that this is something foundries could well afford. Mr. Ramp insists that the durability of these

plates of wood under the trying conditions of damp sand, and dry storage afterwards, is remarkable. We quote as follows: In order to make these wooden stripping boards so that they will not warp or crack while in use, and to wear nearly as long as the metal ones, the lumber should receive the following treatment: Cut the lumber into pieces of the size required for the boards allowing ⅛ of an inch for finishing after the material is treated, and place them in a tank of boiling crude paraffine, a tank especially designed for this purpose as shown in Fig. 1.



The boards should be allowed to boil for ten or twelve hours, after which the steam should be turned off and the paraffine allowed to cool until it begins to congeal. The lumber may then be taken out and the excess of paraffine scraped off. Care should be taken to see that the lumber is not removed from the paraffine while it is too hot, as it will not retain the paraffine when at a high temperature.

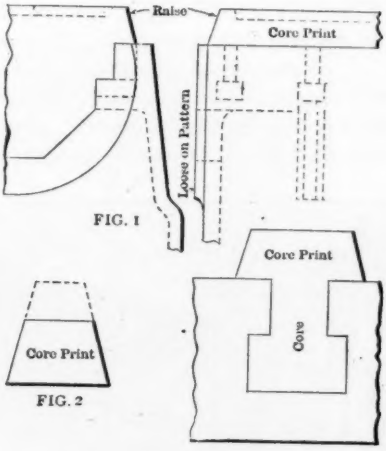
The tank of boiling paraffine should be constructed as shown in the illustration, which is a sectional view of a tank used by the writer for treating boards used on 16x26 and 20x30-inch molding machines. This tank measures 48 inches long, 28 inches deep and 30 inches wide. It is really a tank within a tank, the heat being applied by a system of steam pipes between the outside and the inside tanks.

AMERICAN MACHINIST.

Core-print and Core-box suggestions by Mr. H. J. McCoslin of Cleveland. This article contains some good things from which we quote the following:

A good proportion for the standard core print is as per

Fig 2. Take the diameter of the core for the base and height of layout, one-half the diameter for the smaller end, and then



CORE-PRINT SUGGESTIONS.

use that portion of the layout for hight of print that the case may require.

The setting of deep cores, especially where they cut through the outer wall of metal, as on bearings of engines and bed, etc., is often interfered with by sand being disturbed and falling to the seat of the core. This can be avoided by placing a slight raise around the edge of the print, as then any sand disturbed will fall below seat of core; see Fig. 1.

Fig. 3 shows a practical way of making the print and coring T-bolt head slots and other cores having overhang with small surface for setting the same. Make the print slightly wider than the head of core, exposing more surface of the former to the flow of the metal, which will hold the core in position without the use of chaplets.

A double service Wood Planer.—While we have been patting ourselves on the back as the foremost nation in the production of wood-working machinery, here is a concern, namely—John Pickles and Son, of Manchester, England—makers of double

service wood-planers, that is far ahead of anything for pattern shops ever produced in this country.

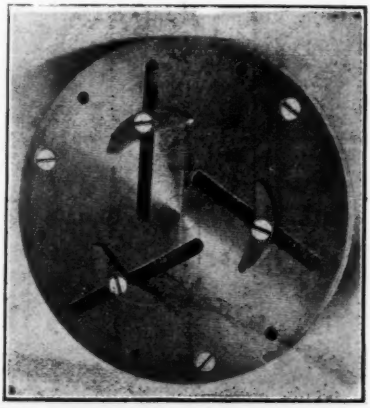
It is nothing less than a jointer and "thickness planer" in one, and it would seem that our wood working machinery concerns had better get a move on in this direction pretty fast, if they want to compete with John Bull. We quote a little:—

A Double Service Wood Planer.

The half-tone shows an interesting machine which should be of great usefulness in pattern shops, etc. Material may first be surfaced upon the upper table and then passed back on the lower

table and under the cutters to be planed to any required thickness.

For the lower table a power feed is provided, and the table may be angled slightly so that stuff can be planed taper to give draft, as generally required in a pattern for molding. Pressure bars



are provided close to the cutters, so that long or short lengths and the thinnest stuff can be planed. The working side of the machine is free from gearing or belts. The cutter runs at 4,000 revolutions, and the feed is about 30 feet per minute. The machine is made in several sizes to plane from 16 to 30 inches wide, each size taking 9 inches in depth.

Patternmaker's Chuck. "This chuck is designed especially for patternmakers, and will center a circular piece of work instantly, as the front plate requires but part of a turn to open the jaws wide or to run them to the center. The chuck body has a hub threaded to fit the lathe spindle, and to its recessed face are pivoted three flat links or arms, the outer ends of which are connected to the jaws by screws passing through the slots in the thin front plate or cover. As the latter is turned (by means of a spanner) the jaws must of course move in or out, according to the direction in which the circular plate is rotated. The plate is kept in place on the chuck by three shoes fitting and sliding in a dovetail groove formed around the face and near the edge of the chuck body, these shoes being attached to the slotted disk by the three flat-head screws shown near the edge of the chuck. F. R. Inman, 170 Midway street, Providence, R. I., is the inventor."

On pages 270 to 271 there appears a description of how a

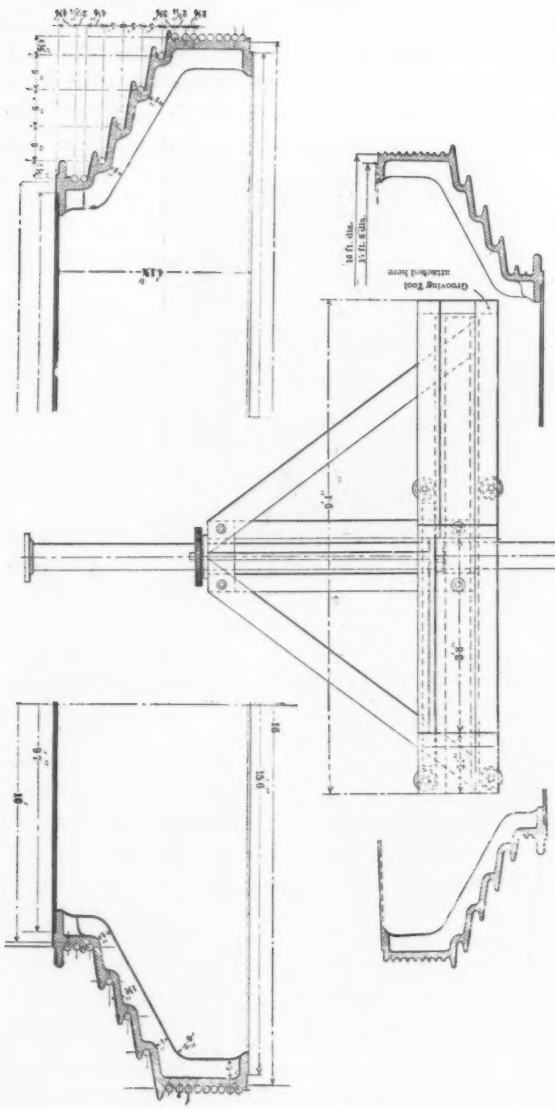
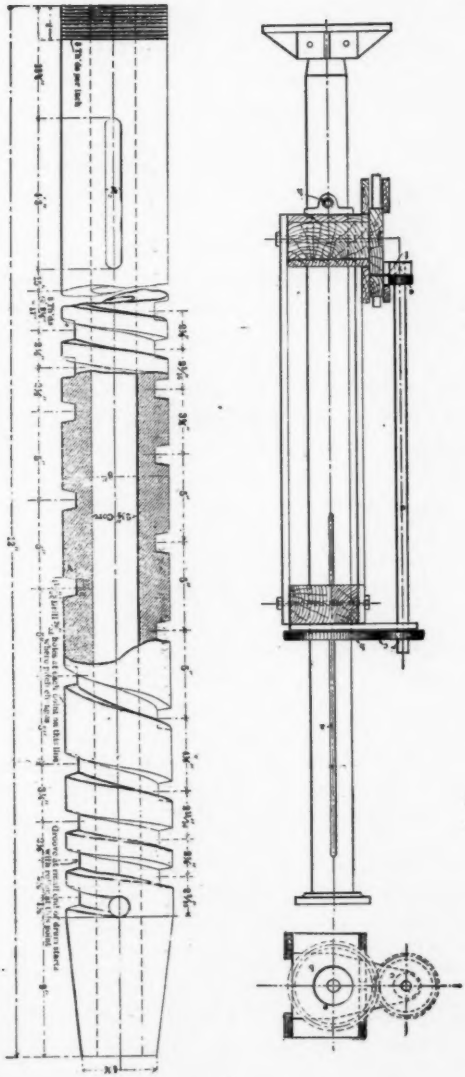


FIG. 2. DRUM AND SWEEPING APPARATUS.



conical hoisting drum was made at the Wellman-Seaver-Morgan Works, at South Akron, O. This is one of the best articles that has appeared in the *American Machinist* in years. We give it in full and without comments.

The drum will be seen to be 16 feet in diameter at the large end and 10 feet at the small end, the conical section being very flat and increasing from the small to the large diameter in four revolutions.

The mold was made by the sweeping process, which is, however, complicated by the conical portion of the drum and by the further consideration that the disposition of the rope calls for several different axial pitches in the length of the drum. Fig. 2 shows the section of the drum in its relation to the sweeping apparatus. The mold was first swept to the inside profile of the drum and the core was then made in place to be lifted out and finished, after which the mold was swept out to the bottom of the grooves, after which the grooves were cut in the face of the mold. Fig. 3 shows the provision for sweeping the conical portion of the mold. A long keyway A, in the upper end of the spindle holds the gear B from turning, but permits it to rise as the sweeping frame is turned about the spindle. Gear b drives gear c, which, by means of shaft d, pinion e and rack f, causes the sweep arm g to travel radially as the frame is turned. The variations in the axial pitch of the drum grooves are provided for by a variable pitch thread cut in the spindle, as shown in Fig. 4, the pitch of this thread at each point corresponding with the desired pitch of the drum grooves. Engagement of the sweeping frame with this groove is by a roller bearing conical roller located at h, Fig. 3, and shown more fully in Fig. 5.

THE METALLURGICAL SECTION

Edited by HERBERT E. FIELD, Secretary of the Metallurgical Section of the Association, Address all correspondence direct to him, P. O. Box 432, New York City

SEGREGATION IN SULPHUR STANDARDS.

Communicated to the Secretary by Mr. H. E. Moyer.

Having learned by experience that cast iron borings deteriorated, in that they refused to give as high sulphur results by

the evolution method after they got old, (we found them unsafe to use after 30 to 60 days) we endeavored to get a piece of cast iron as free from segregation as possible for the purpose of having a source for fresh borings. Our first effort was a complete failure but it gave us the hint, which resulted in a casting that did not vary more than 0.001 to 0.0015 at a sulphur content of 0.045. At first we endeavored to get a uniform casting by stirring up to the time of setting. This casting was 7" high and 7" in diameter. A hole bored through the centre from top to bottom gave the following results: Upper 2-½" No. 1 to No. 6 in rotation—.059-.056-.057-.051-.051-.051. Thence to the bottom No. 7 to No. 12 again in rotation—.050-.050-.034-.027-.026-.032. The effect of stirring, if anything, was to aggravate the segregation. These results gave us the idea of making the casting wide and low,—so low that the chilling would take place before the sulphur could migrate to other places. This casting is 2 ft. in diameter, and 1¼" high. Before drilling, a place is chipped and the wheel bored clear through. In this way we have never had, with careful work, a standard which varied more than I have mentioned, which variation is within the limits of error of any workman.

The Analysis of eFrro silicon. H. Lidholm.
(Zeit, f. angew. Chem., 1903, xliv., 1060; through Analyst, 1904, 18.)

The author overcomes the difficulty in dissolving these alloys by fusion with sodium peroxide, moderating the violence of the reaction by the addition of alkaline carbonates.

METHOD. From 0.2 to 0.3 grammes of the alloy is weighed and mixed with five times its weight of a mixture of sodium and potassium carbonates in a nickel crucible. The crucible is then gently heated to drive off moisture. To the dry mass is added twice its weight of sodium peroxide and the mixture gradually fused, continuing the heat until all lumps have disappeared. The crucible is then cooled, the melt dissolved in warm water, the solution acidulated with hydrochloric acid and the silicon and iron determined in the usual manner.

Determination of Sulphur in Coal and Coke. R. Nowicki.
(Stahl and Eisen, 1903, xxiii., 1141: through Analyst, 1904, 57.)

This method is a modification of Eschka's involving the

use of oxygen introduced by means of the lid of a Rose crucible. METHOD. One gramme of the powdered sample is mixed with 2 grammes of Eschka's mixture and the mass packed in a platinum crucible so as to leave a vertical cylindrical air space in center. The lower part of the crucible is heated to a dull redness while oxygen is introduced into the upper part through a Rose crucible cover. The mass is stirred every five minutes until the ignition is complete. The time required for ignition being from twenty to thirty minutes. The remainder of the operation is conducted as usual.

Determination of Manganese in the Presence of Iron. G. V. Knorre. (Zeit. f. angew. Chem. 1903, xxxviii., 905; through Analyst, 1904, 16.) This is an improvement upon his persulphuric acid method as given in *Analyst*, 1902, 68.

METHOD. The sample is dissolved in sulphuric or a mixture of nitric and sulphuric acids; methyl orange is added and the acid neutralized with ammonia or potash. Ammonium persulphate is then added, using 3 to 4 grammes to each gramme of iron. The solution is diluted to about 300 cc; 20 cc of dilute sulphuric acid (Sp. gr. 1.17) are added and the liquid boiled for fifteen or twenty minutes. The manganese is thereby precipitated as the dioxide and the excess of persulphuric acid is destroyed. The liquid is then cooled; an excess of a standard solution of hydrogen peroxide added and the operation finished by Julien's method, titrating the excess of peroxide with permanganate. The author cautions that the presence of too large an amount of phosphoric acid will produce low results but that the amounts usually present in iron and its ores will have no appreciable effect.

A. S. M.

Engineering Record, Feb. 13, in an editorial demonstrates the urgent necessity of Municipal Testing Laboratories. Immense quantities of material are used yearly by cities for their bridges, docks, pavements, etc., which should be tested for quality before acceptance. Every large city should have such a laboratory and if possible pattern it after that of the P. R. R. in Altoona. Necessarily these laboratories should be absolutely divorced from politics.

Druggists Circular and Chemical Gazette gives the following method of applying bronzes. Solution of equal parts amyl acetate, acetone, and benzine, with enough pyroxylin to give it

body. Powdered bronze added, and the paint so formed applied with the brush.

Engineering and Mining Journal, March 3d, calls attention to inaccuracy of results on aluminum when estimated by "difference." The article is by Mr. C. E. Rueger. Serious differences are shown on the same slag or cement sent to different laboratories. The following method is advocated: Pass H_2S through filtrate from silica. Filter, if necessary, boil off H_2S, oxidize iron with HNO_3 or $KClO_3$. Precipitate iron and aluminum as usual with ammonia and ammonium chloride. Filter and wash. Dissolve in hot HCl, dilute filtrate until lukewarm, nearly neutralize with Na_2Co_3. Add 10 grms. powdered sulphite of soda, stir until completely dissolved. A permanent precipitate should appear. If not add more sulphite. Dissolve ppt. in very slight excess of HCl. Cover with watch-glass, heat to boiling. As temperature increases, the color of the solution fades, and bubbles of SO_2 are given off. When this is gone (usually after 10 minutes boiling) take off hot plate and let settle. Filter and wash. As the ppt. may contain iron it is safer to dissolve again in HCl and repeat precipitation. Ignite and weigh as Al_2O_3. Titanium and Phosphorus vitiate results, but zinc and manganese do not interfere. R. S. MacP.

Occurrence of iron in sulphur. R. V. Hasslinger. (Monat hefte der Chemie, xxiv 929.) As every foundryman knows all commercial irons contain some sulphur The converse statement, that all sulphurs contain iron is interesting. The author shows that even the purest sulphur, when distilled, leaves a black residue consisting of probably FEC_3. This, he thinks, exists in the sulphur as a volatile compound of carbon, iron, and sulphur, from which the sulphur only volatilizes on decomposition. Should this surmise be true, it would throw some light on the loss of sulphur by iron drillings.

Action of saline solutions on Metallic iron. (Chem. Zeit. xxvii, 1903). Tests show that when iron is boiled with a solution of ammonium salts, of a normal salt of a heavy metal (Zn, Cu, Cd, etc.) or a hydrogen (acid) salt which exhibits an acid reaction; a soluable ferrous compound is formed. Furthermore that no soluble iron compound is produced when iron is boiled

with a nitrite, chlorate, bromate, or chromate; nor when the acid radical of the salt forms a compound with iron which is insoluble in water. No iron compound is formed when the metal is boiled with any normal salt of the alkali or alkali earth metals, nor with any of their acid salts which have an alkali reaction. The results of these tests give a good basis for studying corrosion in boilers. Normal and alkaline salts of the light metals should not attack the steel, while their acid salts, and all of the soluble salts of the heavy metals, which include Magnesium, should be injurious.

H. E. D.

BOOK REVIEW.

PIG IRON, and its use in the foundry. The fourth edition of this well known book by Prof. Ledebur, published by A. Felix, Leipzig, Germany, lies before us, and contains all the latest information concerning the proper use of foundry pig iron. Commencing with the different grades commercially known, the matter of the physical properties is gone into extensively. We note that among other points, crystallization, melting point, shrinkage, strength and hardness are specially dwelt upon.

The influences brought to play in remelting pig iron for casting purposes come next. Testing cast iron as seen from the German standpoint receives extended notice. Finally we have the proper selection of pig irons for the various classes of castings made commercially.

The book, while specially adapted to German conditions will nevertheless be found very valuable to those of our foundrymen who are familiar with the German language. Books of this kind should be translated and published here, together with comments on American practice.

WANTED

Advertisements under this head one-cent a word each insertion.

CHEMIST.—Graduate Chemist, twenty-four years old, with excellent practical experience in foundry chemistry, desires progresoive engagement. Good references. Address, *Chemist* care of this Journal.

Memoranda on the Results Obtained by the Committee on Standardizing the Testing of Cast Iron, of the American Foundrymen's Association.

While it is rather late in the day to publish tabulated results of the elaborate series of tests made for our Association by its committee on testing cast iron, yet the individual members are very busy men, and the dry work of calculation and tabulation does not appeal to anyone very strongly.

The proximity of the convention prevents extended comment at the present time, but the tabulations are given herewith, so that each one may read for himself, for the present at least, the story of the behavior of the bars under the conditions theywere prepared and then tested. To recall the matter to the minds of our members, the purpose of the work is outlined as follows :—

The plan pursued by the committee provided for about every possible contingency.

The following comparisons were kept in view :—

(a) Differences in results due to the shape of the cross section of the bar. Thus square bars from ½" up to 4" by ½" steps were made The round bars were equal in number and of such diameters that the areas corresponded to these of the square bars.

(b) Differences in results due to the conditions of the test bars. That is whether rough or machined. In cutting down the bars rather more than is usually done was taken off, each size being machined down to the next lower. This was to facilitate comparison not only, but to get nearer the actual service conditions.

(c) Differences in results due to the molds. That is, casting the bars into green sand, and also into dry sand molds.

Two bars of each kind being made in each full set, that is, four in green sand and four in dry sand, two of each to be machined, and there being sixteen sizes for the transverse tests, and eight sizes (up to 2" only) for the tensile tests, a sum total of 192 bars had to be cast. In addition there were chill pieces and fluidity strips. Mr. Thomas D. West devised the system by which all these bars, molded upright, were flooded with some 5 tons of iron and cast within 20 seconds, The result was naturally very satisfactory, but few bars being lost, and a uniform pouring temperature assured during the operation. It may be added that only a few of the sets were full ones, the harder irons precluding machining. The sum total

of all the work meant 1,601 tests on 1,229 bars, involving the handling of 15 tons of metal

The table annexed gives the analysis of the dry sand 1" square test bar of each heat, together with such information that may be essential to note reasons for the selection of the lines investigated.

Series.	Class of Iron	Melted in	Pig Iron used	Size of Heat	Si	P	S
A*	Ingot Mold	Cupola	Coke	60 tons	1.67	.095	.032
B	Dynamo Frame	Cupola	Coke and Charcoal	60 "	1.95	.405	.042
C	Light M'chn'ry	Cupola	Coke and Charcoal	40 "	2.04	.578	.044
D	Chilled Roll	Air Furnace	Cold blast Charcoal	30 "	0.85	.482	.07
E	Sand Roll	Air Furnace	Warm blast Charcoal	30 "	0.72	.454	.07
F**	Sash Weight	Cupola	Coke and Charcoal	15 "	0.91	.441	.218
G	Car Wheel	Cupola	Charcoal and Coke	10 "	0.97	.301	.06
H	Stove Plate	Cupola	Coke	20 "	3.19	1.160	.084
I	H'vy Machin'ry	Cupola	Coke	30 "	1.96	.522	.081
J	Cylinder	Cupola	Coke	10 "	2.49	.839	.084
K	Novelty	Cupola	Coke	5 "	4.19	1.236	.080
L	Gun Metal	O.H. F'rn'ce	Coke and Charcoal	10 "	2.32	.676	.044

* All pig iron

** Nearly all burnt scrap originally from charcoal and coke irons.

Only regularly constituted heats were used, the balance going into commercial castings of the classes designated.

The results of the various tests have been tabulated, and are given herewith. Further extended comment may follow later on.

TRANSVERSE TESTS.

Modulus of Rupture in lbs. per Sq. In.

Area in Sq. In	Rough.				Machined.			
	Square.		Round.		Square.		Round.	
	Green Sand.	Dry Sand,	Green Sand.	Dry Sapd.	Green Sand.	Dry Sadd.	Green Sand.	Dry Sand.
Sand Roll Iron. (furnace)						0.72 Si.		Series E.
0.25	53,230	54,670	80,640	80,530	.....	.....	.....	.....
1.00	51,560	44,180	51,620	48,740	.....	.....	.....	.....
2.25	41,740	46,290	41,420	41,960	.....	.....	.....	.....
4.00	34,700	33,720	55,110	61,770	.....	.....	.....	.....
6.25	41,070	45,300	53,880	57,230	.....	.....	.....	.....
9.00	33,040	35,760	53,540	55,440	.....	.....	.....	.....
12.25	42,110	39,180	52,470	46,890	.....	.....	.....	.....
16.00	43,510	38,780	48,890	53,360	.....	.....	.....	.....
Chilled Roll Iron (furnace)						0.85 Si.		Series D.
0.25	42,990	54,760	38,220	40,140	.....	.....	.....	.....
1.00	44,120	44,010	49,440	49,850	.....	.....	.....	.....
2.25	47,760	67,680	68,130	59,010	.....	.....	.....	.....
4.00	46,710	43,260	65,940	75,000	.....	.....	.....	.....
6.25	56,060	58,100	68,210	62,600	.....	.....	.....	.....
9.00	52,700	54,910	65,850	51,660	.....	.....	.....	.....
12.25	41,470	54,800	63,450	54,840	.....	.....	.....	.....
16.00	49,070	52,480	67,260	63,470	.....	.....	.....	.....
Sash Weight Iron.						0.91 Si.		Series F.
0.25	14,950	15,480	32,270	25,180	.....	.....	.....	.....
1.00	52,920	42,540	58,430	50,050	.....	.....	.....	.....
2.25	59,170	51,130	39,840	53,010	.....	.....	.....	.....
4.00	61,870	51,810	50,130	47,090	.....	.....	.....	.....
6.25	40,490	43,470	49,370	54,430	.....	.....	.....	.....
9.00	42,710	39,160	42,370	45,730	.....	.....	.....	.....
12.25	32,660	32,110	37,260	37,740	.....	.....	.....	.....
16.00	25,210	25,550	28,740	30,220	.....	.....	.....	.....

Area in Sq. In.	Rough.				Machined.			
	Square.		Round.		Square.		Round.	
	Green Sand.	Dry Sand.	Green Sand.	Dry Sand.	Green Sand.	Dry Sand.	Green Sand.	Dry Sand.
Car Wheel Iron.					**0.97 Si.**		**Series G.**	
0.25	63,440	53,230	78,580	79,510	.....	.....	.....	.....
1.00	47,110	44,810	52,600	61,720	43,200	46,080	64,380	52,200
2.25	32,120	28,200	45,880	39,740	44,640	40,680	43,200	46,170
4.00	35,460	32,190	45,970	39,330	27,520	32,760	41,590	37,350
6.25	31,100	33,680	36,480	33,770	30,280	27,200	38,250	36,090
9.00	32,050	32,140	37,610	35,150	28,730	28,960	33,930	28,040
12.25	28,880	29,740	34,370	39,540	30,880	28,600	34,920	31,650
16.00	24,790	24,720	28,210	27,380	26,070	27,740	29,770	31,430
Ingot Mold Iron.					**1.67 Si.**		**Series A**	
0.25	30,980	27,190	66,990	31,160	.....	.....	.....	.....
1.00	37,140	27,530	44,210	33,660	43,200	38,610	26,100	27,840
2.25	32,880	31,320	34,570	33,870	29,340	30,780	39,810	38,120
4.00	29,540	25,550	34,900	31,610	31,150	26,500	34,320	32,290
6.25	28,360	24,040	29,700	27,010	28,810	25,060	30,810	27,980
9.00	26,200	21,180	27,280	26,540	26,980	21,690	26,030	28,660
12.25	23,040	20,470	27,600	23,310	24,210	20,850	23,220	22,430
16.00	23,720	19,220	23,510	22,660	21,710	19,400	25,700	22,920
Dynamo Frame Iron.					**1.95 Si.**		**Series B.**	
0.25	42,940	35,980	32,230	35,110	.....	.....	.....	.....
1.00	39,220	38,380	44,300	49,160	37,440	30,240	40,020	39,150
2.25	39,540	34,900	41,270	44,840	36,670	36,180	44,790	37,800
4.00	33,960	34,460	41,080	39,230	34,750	33,250	38,750	37,270
6.25	31,860	31,990	41,320	40,710	35,760	35,180	34,020	33,910
9.00	29,680	30,050	35,000	35,620	32,740	30,880	35,400	32,810
12.25	27,960	28,350	34,860	35,250	30,000	28,120	32,670	31,170
16.00	.....	25,350	29,630	.....	27,150	25,850	32,300	31,560
Heavy Machinery Iron.					**1.96 Si.**		**Series I.**	
0.25	46,580	45,430	62,170	64,350	.....	.....	.....	.....
1.00	36,000	44,060	53,210	54,180	43,200	46,080	52,200	55,680
2.25	35,290	35,040	43,860	47,100	33,120	39,060	44,900	43,200
4.00	36,120	33,580	42,290	41,320	30,400	32,970	41,600	42,420
6.25	28,510	25,150	33,370	41,160	31,480	33,230	40,580	35,820
9.00	23,850	20,880	33,040	34,970	27,040	30,410	36,030	38,020
12.25	21,150	22,500	28,630	30,270	23,110	22,880	31,650	32,890
16.00	18,380	18,920	24,180	25,240	21,840	25,400	29,350	28,920

Area in Sq. In	Rough.				Machined.			
	Square.		Round.		Square.		Round.	
	Green Sand.	Dry Sand,	Green Sand.	Dry Sand.	Green Saud.	Dry Sadd.	Green Sand.	Dry Saud.
	Light Machinery Iron.				2.04 Si.		Series C	
0.25	40,080	47,860	62,630	50,210	.....	.....	.....	.....
1.00	37,000	39,190	48,050	50,380	.....	.....	55,680	47,850
2.25	32,880	38,780	38,890	43,950	40,230	38,880	47,340	51,350
4.00	36,170	34,550	42,560	40,150	36,990	35,420	42,920	37,550
6.25	30,700	31,150	41,370	40,270	33,770	34,090	38,410	38,960
9.00	30,980	29,230	38,080	37,780	33,290	32,710	36,520	36,290
12.25	29,780	29,150	35,030	35,240	32,310	30,405	34,140	32,250
16.00	28,580	27,780	32,270	31,840	27,860	25,520	36,040	33,510
	Gun Iron (furnace)				2.32 Si.		Series L.	
0.25	69,040	54,160	88,890	87,090	.....	.....	.....	.....
1.00	52,230	44,030	71,570	67,350	53,270	50,400	80,040	71,340
2.25	49,290	46,760	67,060	66,140	47,520	39,600	69,040	71,160
4.00	50,400	49,990	66,980	66,730	46,670	39,680	61,470	53,310
6 25	45,790	45,890	54,830	56,600	46,490	41,940	62,970	67,860
9.00	41,980	43,050	59,010	59,460	41,990	47,830	56,140	59,480
12.25	41,020	41,250	.....	.....	42,790	40,190	56,010	55,480
16.00	.....	.....	.....	.....	36,910	37,830	48,910	48,350
	Cylinder Iron				2.49 Si.		Series J.	
0.25	58,140	45,730	80,030	70,350	.....	.....	.....	.....
1.00	42,350	34,270	51,690	55,500	39,790	39,790	52,200	46,980
2.25	30,880	31,950	33,400	41,900	39,960	38,520	51,040	53,160
4.00	32,600	30,420	43,180	41,320	26,400	26,610	38,110	38,240
6.25	27,280	26,980	37,050	35,480	35,260	30,190	39,600	35,050
9.00	27,830	25,630	40,900	40,170	26,400	24,890	34,470	34,310
12.25	26,530	25,950	33,100	32,080	25,760	26,240	33,570	36,700
16.00	20,300	21,460	26,300	25,850	26,240	26,050	32,020	31,730
	Stove Plate Iron				3,19 Si.		Series H.	
0.25	79,640	51,210	75,670	67,720	.....	.....	.....	.....
1.00	27,980	29,360	42,570	36,920	48,960	43,200	78,300	69,600
2.25	24,960	30,710	42,160	41,420	22,500	24,480	33,250	31,550
4.00	27,980	28,930	40,540	36,940	23,400	25,810	32,290	31,910
6.25	25,650	27,120	27,570	25,920	24,090	24,070	32,470	27,980
9.00	25,620	25,020	33,350	33,550	23,710	24,100	25,540	23,000
12.25	19,620	19,350	31,380	32,380	22,960	24,120	31,260	26,940
16.00	18,870	18,140	25,830	25,450	19,610	18,680	27,270	28,300
	Novelty Iron.				4.19 Si.		Series K.	
0.25	26,980	36,560	33,000	40,310	.....	.....	.....	.....
1.00	25,430	36,490	39,040	42,530	.....	.....	.....	.....
2.25	25,640	26,290	37,760	37,670	.....	.....	.....	.....
4.00	27,120	26,860	33,550	34,560	.....	.....	.....	.....
6.25	25,610	20,030	27,760	29,500	.....	.....	.....	.....
9.00	22,220	24,130	30,890	32,520	.....	.....	.....	.....
12.25	21,350	22,040	26,960	27,800	.....	.....	.....	.....
16.00	18,150	17,960	23,020	24,410	.....	.....	.....	.....

XUM

COMPRESSION TESTS.

In Lbs. Actual Crushing Weight. Half-inch Cubes cut from Centre of Square dry Sand Bars.

Area in Inches.	A (1.67 Si.)	B (1.95 Si.)	C (2 04 Si.)
0.5 x 0.5	29,570	38,360	38,500
1.0 x 1.0	20,010	23,000	24,890
1.5 x 1.5	17,180	20,980	20,750
2.0 x 2.0	13,810	18,130	18,010
2.5 x 2.5	10,950	15,060	17,840
3.0 x 3.0	9,830	13,790	15,950
3.5 x 3.5	9,350	13,160	15,880
4.0 x 4.0	9,100	12,430	14,220

PIG IRON

This department has been established for the use of producers and distributers of pig iron. It is not intended to be an advertisement of their material, but to impart information to foundrymen who are often unable to locate the brands and compositions they want. Correspondence and the free use of this department is urged upon the furnaces and selling agents, who may thereby gain wider fields, and at the same time place the foundryman in position to select from a larger variety of irons than he could before. Communications should be sent direct to our "Journal." P. O. Box 432, New York City.

	Silicon	Sulphur	Manganese	Phosphorus	Total Carbon
ROGERS, BROWN & CO.					
Victoria,	1.50 to 5.00	.019 to .053	1.89 to 2.17	.33	
Buena Vista,	.61	.019	1.65	.30	4 00
Gem,	1.00 to 3.00	.015 to 06	1.50	.40	2.85 to 3 55
Alleghany,	1.00 to 2.75	.03 to .07	1.25	.60	3.60 to 3.93
Crane, Topton, Macungie, Allentown	.75 to 3.50	025 to .06	.75	.75	3.15 to 3.70
Henry Clay,	1.50 to 4.50	.03 to 06	1.00 to 1.30	2.50 to 4.00	3.25
Macungie Malleable,	.75 to 1.50	.04	.75	.15	
Crane Low Phos.	1.00 to 2.00	.015	.15	.025	4 20
Oxford,	.60 to 1 00	.01 to .05	.65 to 1.00	.65 to .75	
Greensboro,	.75 to 5.00	.03 to .06	1.00 to 1.30	.50 to .75	3.75
SUPERIOR CHARCOAL IR'N CO.					
Pioneer, Marquette, Excelsior, Champion,	0.0 to 2.90	trace to .018	.30 to .70	.15 to .22	
Antrim, Elk Rapids, Michgn	0.0 to 2.50	trace to .018	.30 to .70	.15 to .22	
Penninsula,	0.0 to 1.90	trace to .015	.25 to .40	.15 to .19	
Crescent,	0 0 to 2 50	trace to 0.15	.25 to .40	.15 to .19	
H. R. DURKEE, Chicago,					
Ashland,	5 to 10.00				
Briar Hill,	1.00 to 1.25	up to .05	65 to 1.00	up to .15	
Low Moor,	2.00 to 7.00	up to .05	60 to 1.00		
MATTHEW, ADDY & CO.					
DeBardeleben	2.10 to 2.90	0.010 to0.024	0.20	0.80	
South Pittsburg	2 30 to 2,76	0 006 t 0.029	0,90	1 25	
Etowah	2.10 to 2,88	0.012 to0.035	0 50	0 90	
Clifton	2 25 to 2.70	0 020	1.35	0.50	
Nellie	2 10	0 020	0,50	0.50	
Globe	8.00	0.045	1.00	0.90	

TENSIL

Ultimate Strengt

Area in Sq. In.			0.25		1.00			
Finish			Rough		Rough		Machined	
Sand			Green Sand	Dry Sand	Green Sand	Dry Sand	Green Sand	Dry Sand
Series	Si.	Bars						
G	0.97	Sq.	29,230	28,770	23,270	20,980	28,040	27,600
		Rd.	31,000	30,390	26,560	23,400	27,080	25,960
A	1.67	Sq.	15,750	15,230	13,590	13,010	15,170	13,160
		Rd.	15,490	14,950	13,280	13,470	13,650	13,500
B	1.95	Sq.	16,680	16,020	15,050	15,100	17,700	17,400
		Rd.	16,370	16,740	15,350	16,190	18,520	16,850
I	1.96	Sq.	19,000	17,480	14,050	14,810	19,600	23,560
		Rd.	23,620	16,480	21,850	14,050	18,040	16,800
C	2.04	Sq.	17,070	16,560	16,000	15,900	18,050	18,090
		Rd.	17,550	17,120	16,200	16,010	17,460	18,090
L	.32	Sq	32,300	32,080	22,450	24,880	28,440	30,560
		Rd.	33,610	32,610	29,570	32,380	32,880	31,760
J	2.49	Sq.	18,580	19,360	17,000	17,450	20,120	20,760
		Rd.	22,960	22,440	18,210	17,610	23,440	22,920
H	3.19	Sq.	20,850	19,560	14,520	15,340	23,280	20,400
		Rd.	21,760	17,500	14,260	17,170	21,600	20,680
K	4.19	Sq.	19,120	20,380	14,760	14,850	.....	.....
		Rd.	21,650	24,470	17,340	17,610	.....	.....

(Note) No Tensile Tests were made on bars from Series D. E. and F.

XUM

TENSILE TESTS.

Ultimate Strength in Lbs. per Sq. In.

		2.25					
Machined		Rough		Machined		Rough	
Green Sand	Dry Sand	Green Sand	Dry Sand	Green Sand	Dry Sand	Green Sand	Dry Sand
28,040	27,600	18,100	17,940	23,600	22,400	14,950	13,45
27,080	25,960	19,340	18,330	24,480	20,200	15,530	14,46
15,170	13,160	11,830	12,140	13,230	13,210	10,440	10,18
13,650	13,500	12,190	11,580	12,950	13,020	10,870	10,33
17,700	17,400	13,090	12,520	14,980	14,530	10,980	11,21
18,520	16,850	13,410	13,660	14,620	14,970	11,370	11,05
19,600	23,560	11,240	13,260	14,950	14,700	10,560	11,25
18,040	16,800	11,290	13,460	14,120	14,080	9,780	10,93
18,050	18,090	12,090	12,460	14,550	13,760	10,910	11,10
17,460	18,090	14,290	13,370	14,830	15,380	11,980	11,28
28,440	30,560	19,110	23,060	25,670	26,880	16,800	16,96
32,880	31,760	22,680	28,250	31,300	30,540	17,400	17,87
20,120	20,760	15,050	14,300	18,010	17,900	14,780	14,20
23,440	22,920	16,940	16,600	20,070	19,660	15,490	14,97
23,280	20,400	11,590	14,690	16,440	15,420	10,290	11,89
21,600	20,680	15,320	12,290	14,920	16,040	10,610	10,37
.....	.....	11,610	12,100	.....	.....	8,630	9,60
.....	.....	16,220	15,040	.....	.....	12,700	11,26

4 00

n	Machined	
Dry Sand	Green Sand	Dry Sand
13,450	17,650	16,630
14,460	17,810	17,180
10,180	11,140	11,690
10,330	11,030	10,800
11,210	12,460	12,100
11,050	13,140	13,180
11,250	10,290	10,830
10,930	11,110	10,270
11,100	11,130	11,330
11,280	11,890	10,330
16,960	21,730	19,760
17,870	20,890	23,500
14,200	16,240	15,900
14,970	18,630	16,840
11,890	10,980	13,600
0,370	13,380	11,330
9,600	.....	.....
1,260	.....	.....